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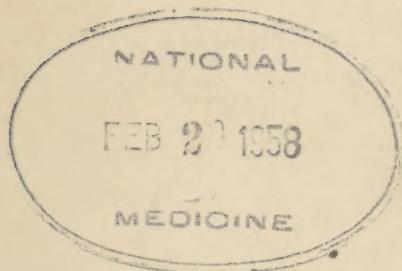


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ABSTRACTS of ORTHOPEDIC SURGERY for 1950

97



OFFICE OF THE SURGEON GENERAL

DEPARTMENT OF THE ARMY

WASHINGTON, D. C.

October 1957

**ABSTRACTS OF ORTHOPEDIC
Surgery for 1950**

Prepared by the Orthopedic Services

of

The Medical Departments of the United States Armed Forces

Department of Defense

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The completion of these Abstracts of Orthopedic Surgery for 1950 has been delayed by various causes. Two chapter editors defaulted, another, to the sorrow of us all, had a fatal heart attack before his chapter was completed, and the Editor-in-Chief was transferred overseas where, to say the least, the situation was not conducive to completing the abstracts. Despite the delays arising subsequent to these vicissitudes, so many men worked so hard and so well to abstract these many articles that there can be no other thought than to publish them; late as they are. Of over 3000 titles obtained from the 1950 Current List of Medical Literature, 1312 have been abstracted.

The value of perpetuating this work is believed generally, by civilian and military orthopedists alike, to be questionable. Many medical journals, e.g., Excerpta Medica, Surgery, Gynecology and Obstetrics, Journal International College of Surgeons, and others, publish abstracts on a world wide basis. Therefore, with this volume the orthopedists of the Armed Forces bow out.

The Editor-in-Chief expresses his gratitude to the men who worked to make this volume possible.

Washington, D. C.
August 1, 1957

Milton S. Thompson
MILTON S. THOMPSON
Colonel, Medical Corps
United States Army
Editor-In-Chief

ABSTRACTS OF ORTHOPEDIC SURGERY FOR 1950

EDITORIAL STAFF

EDITOR-IN-CHIEF

Milton S. Thompson, Colonel, MC, USA

TABLE OF CONTENTS

CHAPTER I

William S. Dandridge, Lt. Colonel, MC, USAF

CONGENITAL DEFORMITIES, GROWTH, AND DEVELOPMENT. Congenital Deformities: Scope and Incidence, 1; Etiology, 1; Systemic Anomalies, 2; Upper Extremities, 2; Head and Trunk, 3; Deformities of the Hip, 4; Lower Extremities, 6. Growth and Development: Normal Growth, 7; Anthropological Aspects, 8; Experimental Work on Growth, 8; Restriction of Bone Growth, 9.

CHAPTER II

A. A. Grebe, Colonel, MC, USA
Irwin E. Rosin, Major, MC, USAF

DISEASES OF GROWING AND ADULT BONE AND MUSCLES. Heredity Bone Conditions, 16. Infectious Bone Diseases: Syphilitic Conditions, 17; Echinococcus Infections, 17; Fungus Infections, 18. Metabolic Disorders: Vitamins and Their Effects, 18; Rickets, 19. Conditions Involving Bone Formation: Osteitis Condensans Ilii, 20; Osteopetrosis, 20; Osteosclerosis, 21; Infantile Cortical Hyperostosis, 21; Paget's Disease, 22; Other Conditions, 24. Conditions Involving Bone Destruction: Osteoporosis and Osteomalacia, 24; Avascular Necrosis, 26; Conditions Involving the Nervous System, 28; Hyperparathyroidism, 28; Neoplastic Bone Diseases, 29.

CHAPTER III

Clarence R. Brown, Lt. Colonel, MC, USA (Deceased)
John D. Ashby, Major, MC, USA

TUBERCULOSIS. General Considerations: Clinical Aspects, 37; Pathogenetic, 37; Laboratory, 38; Age and Race, 38; Forms and Types, 38. Regional Considerations: Head and Trunk, 38; Spine, 38; Upper Extremity, 39; Lower Extremity, 39. Therapeutic Considerations: Streptomycin, 39; Streptomycin Experimental, 40; Para Amino Salicylic Acid, 40; Other Inhibitory Agents, 40; Surgical Treatment, 41.

CHAPTER IV

Robert F. Legge, Captain, MC, USN

MISCELLANEOUS SUBJECTS. General Progress, 46. Wound Healing: Delayed Suture, 46; Wound Rupture, 47; Grafts, 47; Tissue Reactions, 47. Peripheral Vascular Conditions: Patho-physiology, 48; Arteriography, 49; Collateral Circulation, 49; Thrombosis, 49; Gangrene, 49. Miscellaneous: Occupational Therapy, 50; Calcium and Phosphorus Content of the Diet, 50.

CHAPTER V

Knox Dunlap, Colonel, MC, USA
James D. Amos, Major, MC, USA

RESEARCH. Endocrine System: Steroids, 54; Other Conditions, 54. Tissue Growth: Requirements, 55; Tissue Extracts, 55; Vitamin Deficiency, 56; Miscellaneous, 56. Vascular System: Anatomical, 57; Clinical Research, 57; Serum Electrolytes, 57. Nervous System: Temperature Regulation, 58; Anaesthesiology, 58; Embryology, 58; Miscellaneous, 59. Muscular System: Strength and Spasm, 59; Physiology, 60; Biochemistry - metabolic, 61; Biochemistry - physiological, 61; Muscle Relaxants, 63. Skeletal System: Osteogenesis, 63; Anatomy, 64; Biochemistry, 65. Miscellaneous, 65.

CHAPTER VI

M. J. Hitchko, Lt. Colonel, MC, USA
Roy C. Rounds, Lt. Colonel, MC, USAF
Pedro J. Collazo-Gonzalez, Captain, MC, USA
Gerhart J. Knauer, 1st Lieutenant, MC, USA

POLIOMYELITIS. History, 72. Research: Bacteriology, 73; Serology, 75; Physiology, 75; Pathology, 75. Epidemiology: General, 75; Regional, 75. Clinical Aspects: General, 76; Etiology, 77; Diagnosis, 78; General Treatment, 78; Specific Treatment, 78; Treatment of Associated Pain, 79; Surgical Treatment, 79; Other Modes of Treatment, 80; Prognosis, 81.

CHAPTER VII

Chalmers R. Carr, Commander, MC, USN

NEUROMUSCULAR DISORDERS EXCLUSIVE OF POLIOMYELITIS. Cerebral Palsy: General, 86; Drug Treatment, 88; Orthopedic Treatment, 88. Myopathies: Congenital, 89; Myasthenia gravis, 89; Atrophies and Dystrophies, 91; Miscellaneous, 92. Nervous System Disease of Various Causes: Multiple Sclerosis, 94; Paralysis agitans, 96; Guillain-Barre Syndrome, 97. Traumatic Infections and Toxic Lesions: General, 97; Peripheral, 98; Spinal Cord, 100; Brain, 103. Pain: General, 104; Miscellaneous, 105.

CHAPTER VIII

Oscar S. Reeder, Colonel, MC, USAF

FRACTURES. General: Treatment, 117; Research, 119; Complications, 119. Head and Trunk: Head, 120; Vertebrae, 120; Pelvis, 120. Upper Extremity: General, 121; Humerus, 121; Radius and Ulna, 121; Hand, 122. Lower Extremity: Hip Region, 122; Femur, 124; Patella, Tibia, and Fibula, 126; Foot, 127.

CHAPTER IX

Ernest A. Brav, Colonel, MC, USA
John D. Blair, Colonel, MC, USA

FRACTURE DEFORMITIES. Consideration of Fracture Deformities in General: Review of Literature, 132; Treatment of Bowlegs, 132; Intramedullary Nailing, 133. Bone Grafts: Preservation, 133. Regional Fracture Deformities: Upper Extremity, 135; Trunk, 136; Hip - arthroplasty, 136; Hip - other procedures, 136; Femur, 137; Knee, 137; Tibia, 137; Ankle and Foot, 138.

CHAPTER X

Edwin W. Hakala, Colonel, MC, USA

TUMORS OF BONE AND SOFT TISSUES. Considerations of Tumors in General: General, 142; Scientific, 143. Benign Bone Tumors: Reticulo-endothelial and Lipoid Types, 144; Fibrous Type, 145; Osseous Type, 146; Giant Cell Tumors, 147; Miscellaneous Benign Lesions, 148; Malignant Degeneration, 148. Malignant Tumors: Primary Bone Lesions, 149; Myeloma, 150; Metastatic Malignancies, 151.

CHAPTER XI

Lloyd W. Taylor, Lt. Colonel, MC, USA

CONDITIONS INVOLVING THE THORAX AND DORSAL SPINE. Scoliosis: General Aspects, 158; Treatment, 159; Case Reports, 159. Other Conditions of Dorsal Vertebrae: Ankylosing Spondylitis, 160; Extra-lumbar disc herniae, 160; Scheuermann's Disease, 161; Parasitic Infections, 161; Miscellaneous Conditions, 161. Conditions of Thoracic Vertebrae, 161.

CHAPTER XII

Robert S. Brua, Colonel, MC, USAF
Herbert E. Block, Lt. Colonel, MC, USAF

LOW BACK. Low Back Conditions: Anatomical, 165; General, 166; Conservative Treatment, 167; Psychosomatic, 168; Surgical Treatment, 168; Spondyolisthesis, 169; Miscellaneous, 170. Ruptured Discs and Allied Conditions: Anatomical, 170; Roentgenology, 171; General Discussion and Etiology, 173; Diagnosis, 174; Treatment, 175; Results of Treatment, 177. Miscellaneous, 177.

CHAPTER XIII

George H. Chambers, Major, MC, USAF
Jacques G. Robichon, MD
Ingulf U. Medbo, MD

CONDITIONS INVOLVING THE HIP JOINT AND PELVIS. Hip Pain: General, 187; Diagnostic, 188; Non-operative Treatment, 188; Palliative Treatment, 189; Surgical Treatment, 189. Hip Trauma: Dislocations, 190; Fractures, 190. Reconstructive Surgery: General, 190; Resection and Osteotomy, 191; Arthrodesis, 192; Arthroplasty, 193; Other Methods, 194. Pelvis: Anatomical, 194; Coccygodynia, 195; Trauma, 195.

CHAPTER XIV

Thomas S. Barron, Lt. Colonel, MC, USA
Wayne W. Glas, Captain, MC, USA

KNEE JOINT. Knee Joint As A Whole: Anatomical, 201; Effusion and Infection, 202; New Growths, 203; Surgical Treatment, 203; Reconstruction Surgery, 204. Menisci: Discoid Menisci, 204; Injuries, 204. Synovia, 205. Ligaments, 205. Patella: General Aspects, 205; Dislocation and Fracture, 206; Chondromalacia, 206. Quadriceps, 206. Miscellaneous, 206.

CHAPTER XV

Carl M. Rylander, Colonel, MC, USA
James J. Brennan, Lt. Colonel, MC, USA

CONDITIONS INVOLVING THE FOOT AND ANKLE. Foot: Disorders Involving the Toes, 211; Anatomic Deformities, 213; Preventive and Therapeutic Measures, 216; Footwear, 217; Methods of Stabilization, 217; The Factor of Trauma, 218; Specific Conditions, 218. Ankle: Traumatic Conditions, 219; Preventive and Therapeutic Measures, 220; Specific Conditions, 220.

CHAPTER XVI

Victor B. Vare, Lt. Colonel, MC, USA
Howell E. Wiggins, Commander, MC USN

CONDITIONS INVOLVING THE SHOULDER AND NECK. Shoulder Joint: Operative Techniques, 227; Arthrography, 228; Painful Shoulder Conditions, 228; Dislocation of the Shoulder, 230; Miscellaneous Conditions, 232. Shoulder Girdle: Acromio-clavicular Area, 232; Scapular Region, 233; Muscular Involvement, 233. Neck: General Discussion, 233; Cervical Spine, 234; Muscles, 236; Nerves, 237; Cervical Rib, 237.

CHAPTER XVII

Ernst Dehne, Lt. Colonel, MC, USA
David Hull, Major, MC, USA
Duncan Sellers, Captain, MC, USA

FOREARM AND HAND. The Elbow and Forearm: Loose Bodies, 244; Muscles, 245; Monteggia Fractures, 245; Epicondyles, 246; Bony Ankylosis, 246; Miscellaneous, 247. The Wrist and Hand: Neurovascular, 247; Neuropathy, 247; Tendons, 249; Wrist Joint, 252; Carpal Lunate, 252; Carpal Scaphoid, 253; Carpal-metacarpal Joints, 254. The Hand and Fingers: Infections, 255; Hand Surgery in General, 256; Skin Plastic Procedures, 257; Reconstruction of Digits, 258; Dupuytren's Contracture, 259; Miscellaneous, 260.

CHAPTER XVIII.

August W. Spittler, Colonel, MC, USA

AMPUTATIONS AND PROSTHESES. Indications and Choice of Procedure: General, 269; Refrigeration, 270; Gangrene, 270; Choice, 271; Effects, 271. Techniques: Shoulder Girdle, 272; Hemipelvectomy, 272; Cineplasty, 273; Krukenberg, 274. Complications: Pain, 275; Scars, 276; Phantom Limb, 276. Construction and Fitting: Fitting, 277; Construction, 278; Suction Sockets, 278; General, 278. After Care: Rehabilitation, 279; Nursing Care, 279; Amputations in Malaya and Israeli, 279.

CHAPTER XIX

Harold S. McBurney, Colonel, MC, USA

NEW DEVICES, PROCEDURES, AND APPARATUS. X-ray Techniques: Planigraphy and Differentiation Techniques, 285; X-ray Examination of the Vertebrae, 286; Radiography of the Hip, 286. Devices: X-ray Aids, 287; Surgical Aids, 287; Other Devices, 288. Procedures: Use of Wires, 289; Diagnostic Procedures, 290; Relief of Pain, 290; Tissue Repair, 291. Apparatus: Splints, Casts, and Supports, 292; Prostheses, 294; Aids for Locomotion, 294.

CHAPTER I

CONGENITAL DEFORMITIES, GROWTH, AND DEVELOPMENT

By

William S. Dandridge, Lt. Colonel, USAF, (MC)
Craig Air Force Base, Alabama

- I. Congenital deformities
 - A. Scope and incidence
 - B. Etiology
 - C. Systemic anomalies
 - D. Upper extremities
 - E. Head and trunk
 - F. Deformities of the hip
 - 1. Scope and incidence
 - 2. Pathogenesis
 - 3. Treatment
 - G. Lower extremities

- II. Growth and development
 - A. Normal growth
 - B. Anthropological aspects
 - C. Experimental work on growth
 - D. Restriction of bone growth

Of the 193 titles considered, 76 have been abstracted in this category. Many of the foreign titles are unavailable, and many others are lacking in meat.

Congenital Deformities

The scope and incidence of congenital abnormalities is presented by MILLER (1) on the basis of a series of 4095 consecutive births, 2.2 per cent being found to have either congenital malformations or disease states. Bone malformations in feeble-minded children are reviewed by MAUTNER (2). Some of the anomalies are reported as occurring in the spine, sacrum, hands, feet, teeth, and fingers. No specific correlations of the anomalies to the type of feeble-mindedness is attempted except the finger characteristic of Mongoloids. ECKHOFF (3) mentions a group of common congenital anomalies, none of which can be considered orthopedic with the exception of syndactyly and other hand deformities. It is felt that the author offers no unusual or interesting methods of correction other than the classical descriptions. He states that severe syndactyly requires free grafting.

In discussing the etiology of congenital malformations, BROCHIER (4) reports that the majority of abnormalities occur in the presence of one of the following three factors: (a) abnormal position of gravid uterus, (b) abnormal nidus of fetation, or (c) compression deformities of intrauterine origin, i.e., multiple pregnancy, abnormal membranes, etc.

Rubella as a cause of congenital malformations is the subject of a case report by GALARCON (5). He states that rubella developed in the first month of pregnancy and that the child was born with congenital cataracts and other anomalies. He correlates this case with reports by other authors substantiating the dystrophic actions of the virus of rubella. LANDE's (6) study of 16 institutional cases of congenital malformations of the postrubella type involves only seven with past histories of maternal rubella. A severe cold is believed to have been the causative factor in five cases and H. influenza in one other. His findings reveal the most common defect in the series to be congenital cataract followed by microcephaly, with a high percentage of these patients showing hypotonia spasticity and grand mal seizures.

Maternal dietary deficiency is suggested by JENTZER (7) as a possible cause of some of the congenital anomalies in man which do not have a clear genetic origin. He cites the work of Warkany and other investigators who have been able to produce congenital anomalies in animals by giving the female a diet deficient in vitamins during the period of gestation.

MASCARENHAS (8) discusses the incidence, mechanism, and treatment of obstetrical paralysis. In his experience, a brachial paralysis occurs in approximately 0.1 per cent of all deliveries. Recovery is achieved in 50 per cent of the cases although this recovery may not be complete for two years after delivery. (Ed: Although obstetrical paralysis is considered a birth injury rather than a congenital deformity, this article is included here.)

Among the articles on systemic anomalies is a case of osteogenesis imperfecta congenita occurring in a Negro presented by SCOTT and WOODING (9). This rare condition has been reported only a few times in Negroes. A case of Ehlers-Danlos syndrome associated with tetralogy of Fallot is reported by WALLACH and BURKHART (10). Search of the literature fails to reveal previously reported, similar, co-existing syndromes. An account of renal dysplasia in a family with multiple hereditary abnormalities is given by HAWKINS and SMITH (11). Clinically, the case is indistinguishable from chronic glomerulonephritis. The congenital skeletal defects in the family include arthrodysplasia of the elbows, iliac horns, rudimentary patellas, and dysplasia of the fingernails. The authors feel that the renal defects are hereditary, as are other abnormalities which involve both mesodermal and ectodermal germ layers.

BRIKEY and BURKE (12) describe a hereditary syndrome consisting of a deformity and luxation of the head of the radius, absence of the patella, posterior iliac spurs, and dystrophy of the fingernails. It is suggested that it be called arthro-onychodyplasia. They describe two cases in one family and cite many similar cases described in the literature. (Ed: It is interesting to note that one of their described cases died at the age of 26 of "chronic nephritis" since the renal lesions have been described by Hawkins and Smith as part of the syndrome. See reference 11.)

Two interesting portraits of dwarfs from the collection of JOHN HUNTER (13) are discussed with biographical sketches of the subjects.

Among the articles on deformities of the upper extremities is a paper

by EMR (14) who describes two cases of congenital bilateral subluxations of the shoulder joint. He reports that one case was associated with no other congenital defects and had perfect function in the shoulder joint, while the other case was associated with numerous other anomalies and had restricted shoulder motion.

Congenital posterior stigmata of the shoulders is described by GONZALEZ-MENESES (15) in his account of three cases of bilateral depression over the humeral head at the tip of the acromion process. He depicts this depression as being funnel-shaped with its base adhering to the osseous surface, and he relates that no other defects in the shoulder were detected by clinical or x-ray examination. In one of the cases, the father is reported to have a similar deformity. The author apparently reports these cases in order to find out if any similar cases have been seen by others.

An unusual anomaly of the superior extremity in a Tarascan Indian girl is reported by EVANS et al (16). They give an account of an 11 year old girl with congenital bilateral defects of the radius and an associated hand deformity. Apparently, most of the previously reported cases have been in Europeans. The partial absence is more rare than complete absence and is more common in males than females.

A case report of congenital abnormality of the trapezium and first metacarpal bone is published by RUSHFORTH (17). These abnormalities are rare, but the author explains them by presupposing the ossification and persistence of one of the minor cartilaginous centers of the trapezium which have been described in the embryo.

The first article on deformities of the head and trunk is a case of osteocutaneous defect of the skull presented by TURRETTINI (18) in which the infant was born of an apparently normal family after an uneventful gestation period. Causative factors are not conclusive except that this is a developmental anomaly.

Mandibulo-facial dysostosis in an eight year old boy is offered by GAYRAL (19). This condition, also known as Franceschetti syndrome, is rare and is characterized by (a) inverse obliquity of the palpebral fissure, (b) atrophy of the malar bone, (c) atrophy of the inferior maxilla and receding chin, and (d) disappearance of the naso-frontal angle which gives a "fish-like" profile.

FAIREBANK (20) gives a detailed discussion of cranio-cleido-dysostosis. Hereditary and familial influences are of importance. Abnormalities of the clavicles and skull are usually present, but other congenital deformities are common: (a) deficient ossification of the pubes, sometimes with complete absence but usually delayed, (b) coxa vara, and (c) abnormalities of the vertebral bodies, ribs, sternum, hands, and feet. The muscles of the shoulder girdle are usually normal and the strength of the shoulders is unimpaired. Occasionally pressure on the brachial plexus occurs from the distal fragment of the clavicle.

The etiology of funnel chest anomaly, a short central tendon of the diaphragm, is discussed by LESTER (21) who has treated 42 cases surgically and who divides them into those operated upon before the rigid deformity oc-

cured and those operated upon when bony deformity is established. In infancy, he feels that separation of the zyphoid process with its attachments to the central tendon from the distal sternum is sufficient to release the sternum and prevent increasing funneling. In adults wedge osteotomies are performed on sternum and ribs, the deformity corrected and position maintained by external wire splint. The psychological effects of funnel chest upon children are emphasized and the point is made that because of the long duration of the deformity, the patient is often unaware of his physical limitations until after the correction of the deformity, when much increased activity becomes possible. No operative morbidity is reported in 42 cases.

MALLOWS (22) describes funnel chest as seen in routine military practice, and finds that in a recent examination of 555 military personnel, the condition was present in 4.6 per cent. The shallowest depression is given as 1/8 inch. No criteria for the diagnosis are given, as to the possible normal variations in shape of the lower thoracic cage. Reassurance is the only treatment suggested. The author, in summary, points out that the condition is of interest because: (a) "its occurrence brings a little variety to routine medical examinations, (b) it is apparently inherited as a dominant characteristic, (c) it may have a significant effect on the position of the heart, and (d) it illustrates the therapeutic value of simple reassurance in appropriate cases."

MAUTNER et al (23) by x-raying 80 Mongoloids demonstrate that 37.5 per cent anomalies were found in the lower spine, as compared with five per cent anomalies in the general population. There were other congenital malformations, but the preponderance were spinal. The higher instance of spinal deformity in the younger age group of Mongoloids is attributed to the death of those exhibiting spinal deformities in childhood and adolescence. The Mongoloid habitus is believed to develop during the sixth to ninth week of fetal life, at which time the vertebra is formed.

Diastematomyelia is a sagittal division of a segment of the spinal cord or cauda equina as a result of congenital malformations associated with anomalous development of the vertebrae. NEUHAUSER et al (24) mention that prior to their study of this anomaly, no cases have been reported in which a diagnosis was made preoperatively. The authors present roentgen criteria which are characteristic of the condition and which may facilitate preoperative diagnosis.

A case in which the spinous process is deficient and coexists with spina bifida occulta of T-12 is reported by FOTI (25), and TESCHENDORF (26) discusses static scoliosis in children.

There have been 14 articles on deformities of the hip abstracted. A case report of sacral spina bifida and meningocoele is discussed by NISSEN (27) who shows the importance of general treatment, including bilateral below the knee amputation for trophic disturbance of the foot and improvement in the management of urinary incontinence and returning the patient to society.

Congenital absence of distal segment of the spine is discussed by FREEDMAN (28) in a systematic fashion, including a table of previously reported cases. Neurological and visceral abnormalities are discussed, most

of which are associated with the early development of the lower spinal nerves. The author's single case is reported of a man of 61 years, with absence of the sacrum and coccyx, distal to the second sacral segment, with atrophy or absent muscles below the knee, life long urinary incontinence, weakness of the anal sphincter and hydronephrosis.

The concept that congenital dysplasia of the hip may be the basis for a variety of entities seen in later life is presented by ERLACHER (29), including Perthes, slipped epiphyses, and malum coxae senilis. He develops this concept on the basis of x-rays which are not shown in the publication but from which the clinical data are given. He theorizes that these entities are end points of the dysplastic progression.

The importance of early diagnosis of congenital dysplasia of the hip joint is discussed by HART (30) and its sub-headings, subluxation and dislocation, are considered from the etiologic point of view. The cardinal signs of congenital dislocation in the newborn are listed and again the importance of treatment, if possible from the day of birth, is emphasized. The Frejka pillow splint is recommended for the earliest cases, and for dislocation in older children, the bilateral plaster spica is used. In infants, treatment is said to take three to six months, if the diagnosis is made in early infancy. The importance of complete treatment before the child learns to walk is explained.

Early diagnosis and treatment of congenital dislocation of the hips is also emphasized by FORRESTER-BROWN (31). She outlines the clinical findings seen before and after the patient walks and x-ray signs facilitating an early diagnosis. The "basket splint" and its use in the conservative treatment of this condition is described in detail. Mention is made of surgical treatment and its use in the management of irreducible cases.

The incidence of congenital dislocation of the hip is surveyed by CORRIGAN (32) among the Indian population at Island Lake, Manitoba and found to be approximately six per cent. He shows ratios of unilateral to bilateral dislocation of 6:5 and male to female of 1:6.5. The incidence is found to be familial, with blood relationship being shown in all known or suspected cases.

A mechanical exploration of congenital dislocated hip, based on available uterine space and fetal position, is given by STORCK (33). He states that position is not static and represents motion dictated by space and muscular pressures of the uterus. The author sets up phases of intrauterine development with rotations.

Congenital anteversion of the femur in its anatomical, x-ray, and clinical aspects, together with one case as an example, is reported by HAINES (34).

Open operation for congenital dislocation of the hip is demonstrated by PLATOU (35). The function and radiographic appearance of the hip are usually good in the early years after open reduction, but there is a marked tendency to deterioration 10 to 13 years afterward.

16 case reports of open reduction are presented by INGELRANS and VAN-LERENBERGHE (36) with ages ranging from two to 14 years. These represent 16

open reductions following unsatisfactory closed treatment; no criteria or statistics are included to support the clinical evaluation of satisfactory results.

In an evaluation of open versus closed treatment, SCHOLDER (37), without quoting case statistics, advocates closed methods routinely with open treatment in resistant or older (over five) cases. He has followed four cases with bilateral hip deformities for 15 years.

Bone grafting of osteomized femur by os purum in the surgical reduction of congenital dislocation of the hip joint in children is described by STOL (38).

Two conveniences in treatment of congenital dislocation of the hip in a child are suggested by HALL (39). The first is a canvas deck chair split so as to accomodate a receptacle for urine and feces. In the second, the body portion of a hip spica is removed and the long leg portions of the cast are connected by a V-shaped metal bar. This allows motion in the abduction cast and walking.

EXNER (40) writes on the treatment of congenital dislocation of the hip in infancy without contributing any additional points of interest.

Nine other articles on the lower extremities are included. Pigeon toe deformity in children is the subject of an article by SCOTT and HUTTER (41). Pigeon-toed gait is usually due to rotation alteration in tibia, sometimes to a deformity of the forefoot, and occasionally to internal rotation deformity of the hip. True forefoot deformity (metatarsus varus) should be considered and treated as a clubfoot deformity. The normal average rotation of the tibia in the adult is approximately 20° in a outward direction. Provided no bad posture habits are present to prevent external rotation of the tibia, there are forces active during the daily life of the average child which eventually result in a normal knee-ankle relationship. Several faulty habits are enumerated. Among these are sleeping on the abdomen with the toes pointed inward and sitting in a faulty postural position characteristic of the Japanese in which the feet are turned inward under the buttocks. Diagnosis of the condition is simple, and the deformity is demonstrated in the standing child by rotating the leg until the patella points directly forward. Treatment by casts and de-rotation as well as corrective exercises are usually unsatisfactory. The authors report excellent results from the use of the Denis-Browne splint. By means of this splint, worn during sleeping hours, correction (de-rotation) is started gradually, but, as the child becomes accustomed to the splint, correction may be increased. To avoid knock-knee deformity, the bar separating the feet should not be too long.

FAN (42) reports a case of congenital hypertrophy of metatarsals and toes involving the second and third metatarsals and phalanges on one foot. He describes his surgical treatment.

RICHARDSON (43), in writing on disalignment of the knee, debates the role of rickets in genu valgum, genu varum, and genu recurvatum. The author presents a case of a child with severe bilateral genu valgum deformities due to renal rickets. Genu valgum is also discussed by ROEDERER (44) and genu varum by FORREST (45).

An article by DE WULF (46) and one by SPOTORNO (47) recount the treatment of club feet, the latter advocating transplantation of the anterior tibialis to the fifth metatarsus.

RICHARDSON (48) relates his experience with clubfoot and the importance of correcting the three main components of the deformity in the proper sequence is emphasized. The author feels strongly that marked over-correction should be achieved, preferably in infancy by casts, and he discusses in detail his method of achieving results.

HART (49) discusses clubfeet, concentrating on the treatment by wedging casts. His emphasis is on the order in which deformities are corrected and the technique of applying and maintaining the plaster cast. His method is presented in detail. He favors wedging each cast about two times before changing, and he believes in maintainence of the over corrected position for eight to 12 weeks. The usual follow-up is recommended.

Growth and Development

On the subject of normal growth, an extensive review of the literature between January 1948 and July 1949 has been made by ZAMECNIK and AUB (50). It deals with studies and recent advances bearing on growth and protein metabolism. They divide the review into sections discussing newer methods employed in study of protein metabolism, studies on peptide and protein synthesis, amino acid synthesis and interconversions, amino acid transport across the cell membrane, amino acid requirements and the animal protein factor, amino acid antagonists and peptide-like growth inhibitors, tissue culture studies and growth, hormonal relationships to protein metabolism, and neoplasia as related to protein metabolism. The authors cite 192 articles in the bibliography.

A report on the significance of growth from the Child Research Council is presented by WASHBURN (51).

GLASER et al (52) report an exhaustive clinical study of 500 premature infants observed in the Cook County Hospital during a two year period. In general, their figures compare with previous studies of this type dealing with full term infants. The slopes of the curves showing growth, lie below, but tend to approach those showing the growth of full term infants. Negro infants, who make up the majority of patients for this study, show growth curves paralleling, but lying somewhat below those of white infants. The study was controlled by supplying the parents with free milk and vitamins, and it was felt that when additional foods had to be supplied by the parents toward the age of six months, economic differences in nutrition become a factor. This might explain some of the discrepancies between white and negro children. The articles serve to add basic knowledge to growth studies previously done on full term infants by paralleling those studies with a description of the growth of premature infants.

A rather lengthy article by ROBBINS (53) principally concerns plant or botanical growth, both normal and pathological. It is quite technical concerning botany and enlarges the orthopedist's acumen very little. CHINOY (54) of the University of Delhi, India, reviews his study of growth and development in 260 wheat varieties. The article cannot be recommended to

further one's knowledge of orthopedics.

HILDRETH (55) presents in detail difficulties associated with handedness, i.e., speech difficulty. In a second series of articles he presents a detailed manner of overcoming the speech difficulty and other factors by use of mirror writing and reading, and how to dissociate these factors in retraining handedness.

Anthropological aspects of growth are offered by BUSHRA (56) and SHEPHERD et al (57). Studies by these authors, made of a combined total of 995 adults, present an analytical correlation of a series of measurements of limbs, jaws, trunk, height, and three space dimensions of the cranium and facial height. Their evidence indicates that relative length of a skeletal part to total body length is linear rather than geometric. The correlation between stature and trunk length is approximately equal in males and females.

HALE (58) presents an original article describing the anatomical study intended to quantitate growth of the epidermal ridges of the extremities during the prenatal period. It was observed that the breadth of the ridges with relation to the size of the extremity is expressed by a straight line graph. The number of branches of the ridges increases rapidly at first and then becomes constant over a given area at increasing crown-rump length, indicating that between a certain point of development, the epidermal ridges do not continue to change in pattern, but only in size.

As a measure of maturation, MILMAN and BAKWIN (59) and GRUELICH (60) point out that the epiphyses of the metacarpals, metatarsals, and phalanges are the most useful centers of ossification for studying bone age under six years.

In a paper on temperature influence over human growth and development, MILLS (61) quotes statistics which indicate that a trend has been evident during the last half century toward an increase in the height and weight of American boys and girls and toward an earlier onset of the menarche. He finds that this trend was temporarily reversed during the years of 1930-36, and he attributes this to the increased average seasonal temperature during that period. His evidence is not conclusive, however.

In experimental work on growth, WILDE (62) presents data on studies of capabilities of the urodele forelimb primordium to self-differentiate when isolated in vitro in a nutrient culture medium. Results are conclusive that organogenesis of limb buds will occur provided the explant has epidermal covering. Without epidermal covering, the explant develops histiotypically. The amount of organogenesis exhibited by the explant is dependent on the stage of development at which the explant is made. Increase in the mass of tissue transplanted results in a more mature stage of differentiation in vitro.

The influence of growth hormones on growth is the subject of several articles. DE JONGH et al (63) give experimental evidence that growth hormones stimulate soft tissue growth and thickening of bones even when longitudinal bone growth is prevented.

SILBERBERG and SILBERBERG (64) report their study of the effects of

hormones and nutritional factors on growth, development, and aging of cartilage and bone. Their findings are based on microscopic changes in the epiphyseal disc. The growth changes show the effects of hormones such as hypophyseal extracts, thyroid-parathyroid hormone, and estrogenic and androgenic hormones on the phases of growth. They also demonstrate the effects of vitamins, low caloric diets, and various other diets upon the growth phases.

VAN WAGENEN (65) has been able to double the growth rate and reduce by half the age of the rhesus monkey at the time of menarche by injecting testosterone propionate, 7.5 milligram per kilogram per week.

WEISS and NOBACK (66) conclude from their experiments that the thyroid gland has a role in influencing the time of appearance of the ossification centers of membranes, bones, and primary endochondral bones.

An investigation on the relation of their nutritional status to ossification of the bones of children is contributed by NUTRITIONAL REVIEWS (67) in a series of 162 children ages six to 13 years who were undernourished. Data indicates retarded carpal development to be most marked in boys six to nine years and in girls eight to ten years. The average retardation of bone is 25 months.

IRVING (68) discusses the dietary requirements for calcium and cites numerous studies which have been conducted to determine it. He concludes that the officially recommended daily allowances are too high and believes that 10 milligrams/kilogram body weight/day is entirely adequate for an adult man and nonpregnant female.

JESSOP (69) discusses nutritional deficiencies occurring in the population of Ireland, and methods used in obtaining nutritional data, in an effort to break down the statistics in terms of local dietary customs and income levels. Several interesting peculiarities of the Irish diet are brought out, including the scarcity of meat in the rural areas and the absence of any appreciable demand for cheese in Ireland.

WETZEL and FARGO (70) record treatment of 11 children with retarded growth with 10 milligrams B₁₂ daily. Five of the patients are reported to have responded dramatically as proven by a comparable control series. Other noticeable effects are increased vigor and appetite.

JANES and MUSGROVE (71) report an experimental study on arteriovenous fistulas in dogs and measured the weight and length of the involved extremity after varying lengths of time. Apparently their investigation will have clinical application in the case of patients with retarded bone growth, due to poliomyelitis. In the majority of their animals increased growth was produced in all the long bones of the extremity, and in those which were measured, the temperature of the medullary cavity on the parotid side was greater. This later effect is explained on the basis of increased metabolic activity. It is pointed out that the cardiac effects of arteriovenous fistulas at present prohibit their clinical use in increasing growth.

Restriction of bone growth by metal pins passed through the epiphyseal cartilaginous plate is demonstrated by HAAS (72) in his experiments upon the restriction of bone growth in rabbits and dogs. The pins are used to fit

the epiphysis to the diaphysis, and they effectively stop growth in length on the side of the bone so treated. In some cases, however, there is a compensatory longitudinal growth at the unininvolved epiphyseal plate at the opposite end of the bone. This method has not yet been tried on the humerus, but the author feels it may prove of value.

A technique by SPITTLER and BRANNON (73) for insertion of metal staples to cause arrest of epiphyseal growth varies only slightly from the initial paper as given by Blount. Variations include the use of a temporary guide wire which is checked radiographically. They feel that the periosteum might be elevated to sink the staples flush with the bone.

ARCHIBALD (74) points out that in a group of enuretic children, radiological study reveals a higher incidence of retarded bone age than has been seen in a controlled series of comparable age. It is pointed out that methyl testosterone not only does not tend to accelerate skeletal maturation, but does seem to give relief of enuresis in those children who have retarded bone age.

LEWIS et al (75) report two cases of retarded growth treated with growth hormone prepared by the Armour Laboratory. In one case dwarfism was associated with osseous retardation and hypoglycemia, and in the other the patient was a cretin, age 17, taking thyroid and apparently euthyroid at the time of the testing. In both cases nausea and vomiting resulted from the administration of growth hormone and another case has positive nitrogen retention or elevation of serum inorganic phosphate. It is felt that in the first case the patient should be abnormally sensitive to small doses of growth hormone. In the second case, because the absence of thyroid activity had been demonstrated, it is felt that any possible catabolic effects of thyrotrophic contaminants in the serum preparation can be absolutely ruled out. The failure of growth hormone to produce the anticipated effects in human subjects is discussed.

The clinical pathologic conference reported in the JOURNAL OF MISSOURI MEDICAL ASSOCIATION (76) deals with the case of a 12 year old girl with a history of rheumatic fever, who entered the hospital seven weeks after an episode of arthritic bone pains, dyspnea, fever, orthopnea, coughing, and bloody sputum. Physical examination revealed distended neck veins, respiratory distress, basilar rales and a precordial rough to-and-fro murmur, with pulsating liver edge. The chest x-ray showed bilateral pulmonary infiltration, and this formed the basis of the differential diagnosis, which largely lay between the various members of the so-called collagen group of diseases. Anatomical diagnosis was rheumatic pneumonia, acute rheumatic fever, acute rheumatic heart disease, and congestive heart disease with renal pathology. The article provides an interesting discussion of the pulmonary aspects of the collagen diseases.

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CHAPTER II

DISEASES OF GROWING AND ADULT BONE AND MUSCLES

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- I. Hereditary bone conditions
- II. Infectious bone diseases
 - A. Syphilitic conditions
 - B. Echinococcus infections
 - C. Fungus infections
- III. Metabolic disorders
 - A. Vitamins and their effects
 - B. Rickets
- IV. Conditions involving bone formation
 - A. Osteitis condensans ilii
 - B. Osteopetrosis
 - C. Osteosclerosis
 - D. Infantile cortical hyperostosis
 - E. Paget's disease
 - 1. General
 - 2. Laboratory investigations
 - 3. Case reports
 - F. Other conditions
- V. Conditions involving bone destruction
 - A. Osteoporosis and osteomalacia
 - B. Avascular necrosis
 - C. Conditions involving the nervous system
 - D. Hyperparathyroidism
 - E. Neoplastic bone diseases

There are 94 representative articles abstracted for this chapter.

Hereditary Bone Conditions

Dwarfism is the subject of several articles. A case of dyschondroplasia (Ollier's disease) is reported by NARDELL (1) together with several excellent photographs and x-ray reproductions. The case reported presents the characteristic features mostly on one side of the body with hemangioma

more or less confined to the opposite side. As has been observed in previously reported cases, malignant changes take place. Other cases of Ollier's disease are reported by ROKTA (2) and KIERULF (3).

Synonyms for achondroplasia, reports FAIRBANK (4), are chondrodystrophy foetalis and micromelia. This article gives a complete discussion of achondroplasia which is very well presented. This type of dwarfism is evident at birth in contradistinction to that of chondro-osteodysplasia which is not usually noted for several years. Many cases of achondroplasia die before or soon after birth, but the cases who survive this period usually live in good health for a normal life span.

CURTH (5) writes of two cases of follicular atrophoderma and pseudopelade associated with chondrodystrophy calcificans congenita, and he reviews the literature of this syndrome which has been observed only in females.

A case of dwarfism with total ovarian insufficiency and hypersecretion of gonadotrophic hormone is reported by DE MARCHIN et al (6) consisting of the triad of dwarfism, ovarian agenesis, and a webbed neck with the additional findings in this case of epicanthus, nevi, and supernumerary teeth. The administration of estrogens results in an increased feminization in the patient described. It is suggested that the incomplete development of the bones in this disease is due either to a congenital abnormality of the epiphyseal cartilage or to lack of estrogenic factor.

An article on dwarfism by GREENE (7) has no orthopedic significance, and BULGARELLI (8), in four cases of hepatic dwarfism, stresses the clinical and biochemical characteristics with particular regard to metabolism of carbohydrates.

DUCROQUET and ARVAY (9) report their second case of Morquio's disease, an atypical example in that no kyphosis was present and the muscular ligaments were not markedly flaccid and loose.

A study of 1249 individuals in a single kindred in which facioscapulo-humeral dystrophy occurred is presented by TYLER and STEPHENS (10). There are 58 members of the kindred who manifest the trait described. The clinical manifestations of facioscapulo-humeral dystrophy as it occurs in this family consist chiefly of a characteristic pattern and progression in facial, pectoral girdle, and other muscles. The disease is usually benign, only an occasional patient being severely handicapped. A typical Mendelian dominant pattern of inheritance with complete penetrance and variable expressivity has been demonstrated. The occurrence of other diseases and traits has been studied in detail, but no significant correlation with progressive muscular dystrophy has been found.

Infectious Bone Diseases

Articles on syphilitic conditions include a case of syphilitic bursitis reported by THOMAS and ROOK (11). Hyperostosis of the clavicle as a symptom of congenital syphilis is given as a historical report by KOZHEVNIKOV (12).

On Echinococcus infections of the bone, DARDILL (13) cites his exper-

ience with hydatid (*Echinococcus*) cysts of long bones. He quotes a case of hydatid cyst of the femur necessitating disarticulation of the hip and comments that this is usually necessary when the femur is involved. Other long bones may be saved. The author mentions that hydatid cysts of long bones produce radiographic changes that suggest if not define the etiology.

WOODLAND (14) and SANTACROCE (15) report cases of echinococcus cysts of bone. The former points out that in five of his cases the vertebral joints were affected, while in another the primary infestation was probably in the muscles. The disease is characterized by extreme chronicity with absence of systemic effects and a high mortality. No pathognomonic radiologic signs are found in this disease. He also states that a diagnosis was made in one case at autopsy, and in the remainder of cases the diagnosis was made following operation at which time hydatid cysts were found in the abscess cavities.

Cases of fungus infection are also mentioned. A case of mycosis fungoides with vertebral involvement is reported by NEWMAN (16) which he treated with nitrogen mustard. It is essentially of dermatological interest with incidental finding of vertebral fracture.

Bone involvement in cryptococcosis (torulosis) is reported by COLLINS (17). Among the diseases of man due to fungus infection, cryptococcosis is best known in the form of meningo-encephalitis. The causative organism, *Cryptococcus neoformans*, is also termed *Cryptococcus hominis*, *Torula histolytica*, and several other names which have been applied by different observers. The organism belongs to the group of fungi imperfecti. Both in tissue and in culture, it appears as encapsulated, rounded, budding cells usually five to eight microns in diameter, producing no mycelia or spores. The organisms have frequently been mistaken for lymphocytes or erythrocytes. A characteristic feature of a lesion due to *Cryptococcus neoformans* is the gelatinous or mucoid character of the exudate. The authors review over 200 reported cases of cryptococcosis which reveal 17 instances of bone involvement. Roentgen manifestations of the lesions are not sufficiently characteristic for diagnostic purposes. The lesions resemble those due to blastomycosis, coccidioidosis, and actinomycosis. The lesions in each of these fungus infections are similar in type and distribution and frequently involve joints secondarily. A predilection for bony prominences is noted. Destruction of the bone without periostitis seems to be the rule. The lesions are chronic, and any change occurs slowly. Regression is apparently possible with reformation of bone of normal structure.

Metabolic Disorders

One of the publications on vitamins and their effects is an article on chronic poisoning due to excess vitamin A by CAFFEY (18). Description of the clinical and roentgen manifestations in seven infants and young children is given. Attention is drawn to the fact that prolonged overdosage of vitamin A administered by misunderstanding, enthusiastic mothers may lead to a toxic state in infants which resembles infantile cortical hyperostosis in some ways. The differential diagnosis is discussed, and seven case histories are presented. Complete cure is rapid when vitamin A intake is stopped.

Hypersensitivity to vitamin D in transitory renal osteoporosis is dem-

onstrated by VAN CREVELD and ARONS (19). The authors discuss a number of recent investigations on the significance of function of the renal tubules in the metabolism of phosphorus and calcium. Attention is directed to the hypothesis of Albright according to which vitamin D exerts a primary influence on the excretion of phosphorus by the renal tubules. This is in much the same way as Hunter and Fanconi explain the occurrence of a syndrome which is characterized by dysfunction of the tubules and decalcification of the skeletal system after overdose of vitamin D. The discussion is followed by a description of a patient suffering from a severe form of rickets after three administrations of 300,000 units of vitamin D during the first year of life. Other manifestations of the Fanconi syndrome such as glycosuria, albuminuria, and amino-aciduria are present. Following the administration of dihydroxytachysterol a good clinical roentgenological and biochemical improvement is noticed. The phosphorus balance becomes normal, and important decrease in phosphorus in the urine is seen. The conclusion that the child was hypersensitive to vitamin D is borne out by interchange of the synthetic and the natural vitamin which causes reversal of biochemical changes.

The prevention of rickets is discussed by CORNER (20). Rickets is a generalized disorder of metabolism resulting in diminished retention of calcium and phosphorus in the body. Owing to the great demand of the rapidly growing skeleton of the young child for these minerals, any interference with their metabolism will show its maximal clinical effect as a disorder of growing bone. Experimental work has conclusively proved that the cause of rickets is deficiency of vitamin D and that normally this vitamin is absorbed from the skin directly into the capillary blood or may be absorbed from the alimentary tract with fat-containing foods. The most important function of vitamin D is to promote the deposition of calcium and phosphorus in bone. In considering the etiology of rickets, the prevention of the disease may be discussed from the following aspects:

(a) Treatment during pregnancy and lactation. Pregnancy constitutes a tremendous drain on the maternal stores of calcium. The estimated requirement of calcium in the maternal diet during pregnancy is 1.5 grams. Two pints of cow's milk will supply 1.2 grams, and the remainder may be supplied by other foods. It is essential to supply adequate vitamin D with the calcium intake, and it is estimated that 800 units daily are desirable. This calcium and vitamin intake should be kept up throughout the period of lactation.

(b) Action of sunlight. Rickets may be prevented by exposure to sunlight or to artificial ultraviolet radiation. Dust, smoke, fog, shadows, etc. all interfere with the contact of the sun's rays with the infant's skin. Whenever temperature permits, the child's whole skin should be gradually exposed to sunlight until a good tan is obtained.

(c) Dietary measures. Breast feeding has some effect in the prevention of rickets. The calcium content of cow's milk is very high, but it requires the addition of vitamin D. When digestive abnormalities are present, due allowance should be made by giving larger vitamin and calcium supplements. Addition of foods particularly for their mineral content early in infant's feeding is an important dietary measure.

(d) Vitamin D supplements. It is stated that all normal infants re-

quire a vitamin D supplement which should be started at the age of four weeks and continued up to five years. Vitamin D supplement may be supplied by way of standard cod liver oil or concentrated preparations of vitamin D.

(e) Requirements of abnormal infants. Premature infants or small twins require 3000 units of vitamin D daily, and this should be started on the seventh day of life. A child with chronic steatorrhoea has need of large doses of vitamin D and calcium during the period of active growth.

Fanconi's syndrome or the association of rickets, glycosuria, hypophosphataemia, and mild acidosis, reports HINGSTON (21), is extremely rare. The etiology of the condition is uncertain, but a hereditary influence is known to exist. It is said to be due to a defect of the renal tubules which renders incompetent the reabsorptions of glucose, amino acids, and phosphates. This explains the increased amino acids in the urine, the often decreased blood proteins, and the glycosuria. The defect is said to be in the proximal renal tubules where glucose and phosphates are normally reabsorbed. The condition being a congenital and often hereditary defect of the renal tubules, treatment is unfortunately of little avail.

BOHNING (22), MORRICA (23), and DE GAETANO (24) discuss various aspects of rickets and various means of treatment. One endeavors to correlate it to juvenile dystrophy of the bones of the foot; another recounts the use of vitamin B₁ as a preventive remedy and uses massive doses of vigantol.

Conditions Involving Bone Formation

Six cases of osteitis condensans ilii are briefly reported by UDE (25) with reference to the roentgenologic changes in the pelvis and in the dorsal and lumbar regions of the spine. The author gives the following data pertaining to the patients: five of the individuals were female and the other was male; the age range was from 26 to 66 years; two of the females were single and three were married. His findings reveal all six cases to have changes in the spine consistent with those residual from juvenile epiphysitis and the sequelae of this condition, and three of the cases to have an associated degenerative process in the region of the pubic symphysis. The unilateral condensing osteitis, seen in the youngest patient of this group with evidence of narrowing of the involved sacro-iliac joint, casts doubt on the supposition that condensing osteitis is not associated with joint involvement and might suggest that this contention has been made on the observation of cases with only bilateral involvement where both joints show identical changes. It has been established that epiphyseal growth centers are present during the growth period on the auricular processes of the ilia, although they are not described in all anatomy textbooks. Since the etiology of osteitis condensans ilii is still obscure, the simultaneous presence of this condition with vertebral epiphysitis suggests the possibility of a common etiological factor. The immediate impression is that the first condition represents secondary sclerosing changes superimposed on juvenile epiphysitis of the sacro-iliac joints. It would be comparable to the changes which develop in any weight-bearing joint where the joint structures have been altered by a disease process.

SEIGMAN and KILBY (26) report a case of osteopetrosis and review recent literature on the subject. The rare and interesting abnormality of

osseous development is the "marble bones" first described in 1904 by Albers-Schonberg who used that term because of the characteristic dense appearance of the skeletal system. The diagnosis of the disease rests mainly upon the roentgenological findings. It may, however, be recognized clinically by the secondary changes produced, particularly in the more severe forms. Roentgenologically, the bones of the entire skeleton are homogeneously opaque. The vertebrae, the pelvis, skull, proximal ends of the femurs, and the distal ends of the tibia and fibula are most severely affected. Bone length is usually normal, but clubbing of the ends of the long bones may be noted. In the skull, the suture lines are often wider than normal, the posterior clinoid processes are clubbed, and the sella turcica is shallow. The paranasal sinuses and mastoid cells are often not pneumatized or only partially so. Overgrowth of jaw is frequently present. The clinical features most common are (a) multiple fractures which occur with very slight or even no trauma and which usually heal in a normal time although reports of slow union have been published, (b) optic atrophy, (c) anemia, varying from a mild form to plastic type, (d) lymphadenopathy, hepatomegalia, and splenomegalia. In the severe form, children affected with this disease usually show a broad face with a wide flat nose, thickened lips, and prominent frontal bosses. Development is generally delayed, particularly with respect to walking, talking, and dentition. Hydrocephalus, deafness, nystagmus, osteomyelitis, and subarachnoid hemorrhages may be seen. The etiology of this condition is not known, but familial occurrences have been so striking that many authors believe the disease is carried in certain family groups as a recessive Mendelian characteristic. Pathologically, this disease is characterized by generally poor vascularization of the skeleton which is believed to be an important factor in the hyperostosis and hypermineralization which are present. In areas of healing fractures, the vascularity and structure of bone approach normal. Blood chemistry studies are usually within normal limits. The differential diagnosis is usually not difficult. The more common diseases which may be confused with osteopetrosis are syphilis, leukemia, tuberculosis, lead, phosphorus, and flourine poisoning, hypervitaminosis D and A, and Paget's disease. There is no known effective treatment for this condition. Prognosis usually depends upon degree of severity. A mild or benign type may be diagnosed quite accidentally. In the more malignant type, death usually results at an early age from intercurrent infections, anemia, and hemorrhage. If death does not occur, children with this disease are often marked for life by hydrocephalus, blindness, deafness, and multiple fractures.

Generalized osteopetrosis is the diagnosis in a case report by POROT (27). Another case with involvement only of calcaneal epiphyses, bilaterally, is reported by LACHAPELE (28).

Cases of generalized osteosclerosis are reported by PIAZZA (29) and KOHLER and LAUR (30).

Infantile cortical hyperostosis is discussed by MacGREGOR and DAVIES (31). There have been 28 cases of this condition reported. The authors report the second case known to have occurred in England. The characteristics of the disease are described as follows. A young infant in good health suddenly develops a swelling of some part of the body, usually a limb, the face, or the neck. At this stage, there is irritability and sometimes anorexia, but constitutional disturbances are slight if any, and the infant

usually gains weight normally. The swelling is not hot, and the adjacent skin is not red. X-ray examination shows the formation of periosteal new bone involving a part or the whole of the bone most nearly related to the swelling and also involving some other bones. The bones most commonly affected are the mandible, clavicle, ribs, scapulae, and the long bones of the limbs. Not infrequently, there is some fever and leukocytosis with a normal differential count. The disease is active for from eight weeks to nine months, but some x-ray changes may persist. The disorder is benign, and all changes eventually disappear without after-effects. Biopsy shows simple hyperplasia of the cortex beneath an actively proliferating periosteum. Cultures are sterile. When swelling and tenderness of the limbs are accompanied by localized skeletal appearances which have been described, the lesion may be mistaken for a traumatic or infectious process involving only one bone, and it is probable that cases have been overlooked by omitting x-ray studies of other parts of the skeleton.

BRADLOW and STEINBERG (32) report two cases of this malady, and LARKIN and ROUSSEAU (33) report another.

Paget's disease, or osteitis deformans, is discussed by FAIRBANK (34). It is a chronic disease characterized by slowly spreading changes in one or more of the bones. Changes consist of decalcification combined with osteomyelitis with replacement of marrow tissue by vascular fibrous tissue. The cause of the disease is unknown. There appears to be a hereditary influence in some cases. The majority of cases are seen after the age of 40 years, and males are more commonly affected than females. The disease may be confined to one bone, at least for a period of years. The tibia is a common site for a solitary lesion. Sooner or later, however, several bones are usually affected. Not infrequently, the disease is first discovered as an incidental finding. Approximately only 35 per cent of the patients complain of pain. In advanced cases with many bones affected, a crouching or "simian" attitude may be noted with the patient in the upright position. Reduction in stature as a result of bowing of the long bones may be considerable. Enlargement of the circumference of the skull, kyphosis of the spine, and anterolateral bowing of the legs are the common deformities noted. The only significant and constant change of the blood chemistry examination is an increase of alkaline phosphatase. Increased excretion of calcium and phosphorus is also reported, but the amounts have no relation to the severity of the case. The radiographic appearances are quite typical. The bones present a honeycombed or spongy appearance with abnormal striae and areas of increased density or a grossly cystic appearance. The variation in the lesions depends upon the stage of the disease process. In the skull, there is thickening of the outer table and markedly irregular, increased density. The sutures are obliterated, and the coarse mottling presents a picture of the well-known "niggerwool" appearance. Circumscribed areas of bony changes in the skull have been frequently noted. Incomplete fractures are not infrequently seen, are usually transverse, and tend to heal rapidly. Aside from multiple fractures, the most important well-known complication is development of osteogenic sarcoma. The incidence of this latter complication is variously reported as 2.4 per cent to 11 per cent. Paraplegia, urinary calculus, and multiple myeloma may be listed as rarer complications. In well established cases, the diagnosis is usually not difficult when roentgenography is employed.

In the light of two observations, one of a woman with Paget's disease and the other of a man with a fibro-cystic affection of the bone, BEYSSAC (35) reconsiders the question of fibrous osteitis. Too great an importance must not be attached to osseous fibrosis, as it is merely a common reaction of the osseous tissue, existing in Recklinghausen's and Paget's diseases as well as in a number of other diseases of this tissue. It now seems to be generally conceded that fibrous osteitis is the final stage in marked skeletal decalcification. The conception of osteoporosis is more restricted in pathological anatomy than in x-ray diagnosis. Biochemical research, although of great interest, may not always help to establish a precise diagnosis.

FAUCONNIER and KETELSLEGERS (36) and CZICKELI (37) discuss history, clinical examination, radiological findings, blood chemistry, and histological changes of Paget's disease. The differentiation from Recklinghausen's disease is shown in table form.

Results of microphotographic studies of Paget's disease in two cases are given in an account by LASSEUR (38). The following characteristics of the disease are pointed out: (a) destruction of old bone by osteoclasts and (b) formation of new bone by osteoblasts. Both aspects of the process present a disoriented pattern. The author is of the opinion that one of the cases studied is a premalignant stage of the disease.

GOODBODY and ROBERTS (39) investigate basilar invagination in Paget's disease, and SCHNEEBERG (40) cites observations on the glucose tolerance test in Paget's disease. The latter states that previous reports of studies of glucose tolerance tests in patients suffering from Paget's disease have indicated abnormalities characterized by high post-absorptive blood levels. Acceleration of the rate of intestinal absorption and disturbances in endocrine function have been suggested as possible explanations for this variation. The data accumulated from the author's re-study of the problem of glucose tolerance in Paget's disease in patients and in experimental animals fails to demonstrate any significant alteration in patients with osteitis deformans. In addition to the foregoing, a method of experimentally elevating the serum alkaline phosphatase in dogs is described.

Cases of Paget's disease and osteofibroma, each associated with hyperparathyroidism, are presented by KOCH (41) to stress the importance and value of routine x-ray examination. All of the cases presented show dental manifestations. The author points out that often the earliest symptom of bone disease may be manifest in the jaws and that many of these lesions could be discovered earlier if roentgenographic examinations were more generally used.

Other case reports citing various complications of Paget's disease, such as pelvic decalcification, depressed fracture of the skull, bowed radius, and occurrence in siblings, are reported by DE SEZE and ORDONEAU (42), MCPHERSON (43), GODLEWSKI and PALUN (44), LIEVRE (45), and MURPHY (46). The infrequent complication of fractured skull is thought by MCPHERSON to be a pathological fracture although trauma sufficient to produce unconsciousness had been sustained.

Paget's disease in association with an astrocytoma of the right temporal lobe is reported by ESTRIDGE (47). Although it has been repeatedly

reported that the increasing thickness of the skull in Paget's disease is mainly or entirely outward, the existence of cerebral compression by ingrowth of the abnormal bone cannot be doubted. While the occurrence of increased intracranial pressure of Paget's disease has not been reported in the literature, the author presents a simultaneous occurrence of Paget's disease with an intracerebral glioma. FLESCH-THEBESIUS (48) reports it associated with sarcoma of the maxilla.

Material is also contributed on other conditions involving bone formation. Three cases of diaphyseal eburnation of the cuboid and one of the tibia, resulting from direct trauma not causing fracture, are reported by LERICHE (49). The cortical thickening is evidenced on the neighboring bone also. There is marked pain following this eburnation which may recur after wide resection of the bone. The mechanism is unknown.

A case of anomalous ossification of ribs as a cause of pseudarthrosis is cited by ASPIN (50). Many anomalies of the upper ribs are found in the course of routine radiography of the chest. In the past five years, several authors have drawn attention to a particular anomaly of the first rib variously described as a stress fracture, anomalous development simulating isolated fracture, and pseudarthritis. The anomaly presents an irregular transverse discontinuity in the middle third of the bony rib. On the radiogram, the exposed ends often show signs suggestive of sclerosis. Frequently, they are bridged by shadows remarkably like those of callous. It is suggested that rib pseudarthrosis not due to fracture may develop as an intermediate stage in cases where ossification of the shaft progresses from two centers instead of the more usual primary center near the angle of the rib.

A curious case of myositis ossificans blocking the hips is presented by COSTE et al (51). It is that of a female mental patient kept in a straight jacket for six months with myositis ossificans, generalized, but most marked about the hips and elbows. The authors present a long discussion of ectopic bone formation with no new material.

Myositis ossificans progressiva is a rare disease of unknown etiology. FREEMAN (52) presents a case report of a 13 year old female who suffered from stiffness for eight years. Early roentgenographic records suggest an ossifying chondroma at the scapular angle, but later films made eight years after the onset of symptoms show progressive involvement of the erector spinae group, the latissimus dorsi, the scapular muscles, and the intercostals.

True pulmonary osteoarthropathy and related forms are discussed by BARIETY and COURY (53). The etiology, clinical picture, and laboratory findings are reviewed thoroughly. There are 25 new cases presented.

Conditions Involving Bone Destruction

There are several articles in this group which concern osteoporosis and osteomalacia. In writing on bone diseases with osteoporotic or malacic changes, COPELAND (54) states that diagnosis of the various entities described is predicated upon a careful work-up of the case, including the history of trauma, pregnancy, lactation, and the menopause. A dietary history considering the intake of calcium, vitamin D, and protein must be obtained. Adequate x-rays of the spine, pelvis, and long bones are frequently indicated.

X-rays of the skull should be taken on all bone cases. Blood studies including calcium, phosphorus, alkaline phosphatase, non-protein-nitrogen, carbon dioxide combining power, total protein, and formol-gel tests are frequently helpful. Special tests, such as acid phosphatase to rule out metastases from carcinoma of the prostate, urine for Bence-Jones protein studies, urine tests with Sulkowitch reagent, blood sedimentation tests, and sternal puncture all yield significant findings under appropriate conditions. A routine urinalysis and blood count should never be omitted. Stool tests for fat and other abnormalities are to be done when indicated. In short, a careful survey of the patient, with adequate laboratory studies and knowledge of the various causes of osteoporotic and malacic changes which occur, should be of considerable benefit in solving many problems related to bone atrophy or destruction.

SHERMAN (55) presents an excellent historical resume on osteomalacia, an interesting metabolic condition of the skeletal system. She credits Pömmel with establishing, in 1885, the fact that osteomalacia and rickets are identical. More modern and scientific studies have been done by the workers of the Pieping Union Medical School. Their reports, published in 1925, cover most of the phases of the problem. Their findings are as follows. Active osteomalacia is always a manifestation of a negative calcium balance. The urine calcium is markedly decreased or completely absent, and patients derive no benefit from increased calcium intake by mouth. Calcium administered intravenously is followed by calcium retention with improvement of clinical symptoms. This is taken as proof that there is lack of absorption of calcium from the intestinal tract, and, when these patients are given vitamin D or ultraviolet light, symptoms are abolished. It is also seen that true osteomalacia as a deficiency disease has become a great rarity in the western world where diet and hygiene are on a high level. The disease remains common in certain parts of India and China where it mostly affects women, who, due to various social customs, seldom come outdoors or are exposed to sunlight. The men and the lower class women who work outside do not have osteomalacia. The etiological factors of osteomalacia are insufficient vitamin D due to a simple lack of this substance in the patients' diets, or certain gastrointestinal disorders in which the fat-soluble vitamin is not absorbed. The renal factor involved may be due to tubular insufficiency in which the patients have a decreased ability to excrete acid radicals. Another renal factor is seen in the Fanconi syndrome where the constant acidosis is held responsible for the development of defective calcification of osteoid tissue. Idiopathic hypocalcuria is also mentioned as a possibility in certain patients who develop a low kidney threshold and continuously excrete a large amount of calcium in urine at the expense of the skeletal system. In addition to the scholarly discussion of this disease, two cases are presented which the author claims to be the fourth and fifth pathologically proven cases of osteomalacia to be reported from North America.

LEROUX and KERNEIS (56) define osteoporosis and osteomalacia. They present schematically the clinical picture, laboratory findings, and pathogenesis of each disease. Case reports of osteomalacia are contributed by HANSEN (57) and BERTRAND and SALVAING (58). The latter's case is associated with Hanot's hepatobiliary cirrhosis.

In an article on osteoporosis, HOWARD (59) states that generalized

bone deficiency is due to metabolic processes of three types, namely, (a) osteoporosis, in which there is inadequate formation of the protein matrix, (b) osteomalacia, in which there is lack of calcium for calcification of bone, and (c) osteitis fibrosa generalisata, in which there is excessive bone resorption. The various causes and clinical sub-types of osteoporosis are presented, important among them being deficiency of the gonadal hormones. Post-menopausal osteoporosis, which is the commonest osteopathy encountered in clinical practice, is discussed at some length. Two case histories of this condition are given in detail, and these demonstrate a rapid clinical response to combined estrogen and androgen therapy. Improvement in the radiological abnormalities has not yet been observed. This is explained by the slow rate of calcium retention since eight years would be required to replace a 50 per cent loss of bone calcium. Elevation of serum alkaline phosphatase has likewise not been observed. Nitrogen retention during treatment, which indicates increased protein formation, may account for the symptomatic improvement.

KYNASTON (60) discusses osteoporosis of the spine with spontaneous fracture as a possibility among the numerous causes for backache. This disease is more common in females and usually occurs between the ages of 60 and 70 years. The pain is usually in the lower dorsal or lumbar spine. The onset may be acute and associated with a fall or sudden vigorous movement, but more frequently it is gradual. Pain is aggravated by activity and relieved by rest. There is occasional radiation of pain around the chest into the abdomen and into the buttocks and thighs. A Kyphos is usually present at the fracture site. Biochemical examinations are usually within normal limits. Diagnosis is usually evident on x-ray studies of the vertebral column. Various other clinical conditions must be excluded, among them spondylitis, Paget's disease, hyperarathyroidism, thyrotoxicosis, osteogenesis imperfecta, Cushing's disease, and Kummell's disease. Also to be excluded are metastatic malignancy, multiple myeloma, and bone changes due to leukemia. The treatment consists of external support of the spine in extension, together with diet supplements of calcium, phosphorus, and vitamin D.

RAVAULT et al (61) report a case of diffuse decalcifying osteosis associated with eunuchism.

ARDEN (62) reports an instance of unexplained edema of the right ankle which led to x-ray study in a woman, revealing osteopoikilosis in both feet, hands, hips, and shoulders. He states that there were no other symptoms in this case.

In a dissertation on avascular necrosis of bone in children, PEASE (63) discusses the various conditions more normally seen to be the seat of avascular necroses. He is of the opinion that, insofar as local treatment in avascular necroses of the capital femoral epiphysis is concerned, the final outcome of the disease remains the same. Contrary to most orthopedists, Pease is of the opinion that braces and splints do not serve any useful purpose. He places great stress on the importance of the obturator nerve section in selected cases where abductor spasm is present.

AXHAUSEN (64) classifies epiphyseal necrosis with slight bone infarcts.

PIKE (65) outlines a conservative method of treatment of Legg-Perthe

disease, the principal deviation from the generally accepted non-weight bearing regime being prolonged recumbency. There are 29 cases described in which the average length of recumbency was 27 months. The end results are comparable to those of accepted methods of treatment.

VAEYE (66) presents four cases, all of different etiologies, of post-traumatic ischemic necrosis of the femoral head to emphasize the necessity for close follow-up in all traumatic incidents to obviate the diagnosis of aseptic necrosis. If weight is borne before revascularization takes place, deformity and osteoarthritis result. MacDOUGALL et al (67) write of two cases of osteonecrosis of the femoral head occurring in a male and female following extensive irradiation. The literature is reviewed, as well as their own clinical and pathological findings.

COMPERE (68) gives a detailed resume of the operative and postoperative techniques in the correction of deformity and prevention of aseptic necrosis in late cases of slipped femoral epiphyses. The joint is approached anteriorly without stripping the gluteus from the ilium. The capsule is split from the ilium parallel to the neck. A two centimeter wedge is removed from the superior surface of the neck, and the epiphyseal plate is completely removed allowing spongy bone to contact spongy bone. When reduced, it is fixed by three threaded wires. Patients are held in Buck's traction for several days and ambulated on crutches without weight bearing until union is evident, usually about three months. If necrosis is evident, weight bearing is postponed until healing is accomplished.

SIFFERT and ARKIN (69) report the usual findings of aseptic necrosis following trauma in a part which has not previously been reported to be involved in this process.

THELANDER (70) describes a case of epiphyseal destruction by frostbite.

A case of traumatic premature closure of the subcapital femoral epiphyseal cartilage is cited by GHORMLEY et al (71) in a six and one-half year old boy run over by a truck resulting in premature closure of the proximal femoral epiphysis. The author reports that there was some compensation over a four year period followed by a limp due to leverage changes with the shortened neck.

On slipping of the capital femoral epiphysis, SHIMONEK (72) offers some general remarks but no contribution or cases. WALCH (73), however, depicts six cases, of which four were treated by reduction and cast, traction and cast and bone graft, osteotomy, and osteotomy with nailing. He reports that two cases had complications with aseptic necrosis and osteoarthritis. He suggests manipulation and immobilization when the head has not slipped by one-third; when it has slipped over one-third, open reduction with or without fixation is recommended.

Coxa vara is discussed by PUJO (74), VERBRUGGE (75), IHLENFELDT (76), FURMAIER (77), and PAUWELS (78). The latter three discuss etiology from endocrinial, hormonal, and mechanical points of view, respectively. Furmaier bases his opinion on about 300 cases, 50 per cent being bilateral, and he recommends conservative rather than surgical treatment even without correction. Pauwels points out that there is a smaller weight bearing surface in coxa

valga. Theoretically, he considers wedge resection of the subtrochanteric region as the treatment of choice and presents three cases treated in this way 14 years previously. Pujo's article is a general and superficial discussion of the subject with no cases and no statistics, while Verbrugge recounts a study of the epiphyseal plate radiologically and histologically from a case of coxa vara. It shows a lack of development of the cartilage and formation of fibrous tissue. He suggests that traction should, therefore, be employed for reduction and fixation by a nail. If severe with damage of the head, he suggests insertion of a prosthesis with reestablishment of normal head-neck relations.

A paper by MARCOZZI (79) on initial radiographic signs of coxitis in childhood is an analysis of case material with x-rays, and the author gives a discussion of the radiographical findings in early inflammation of the joint. He concludes that (a) bone atrophy is more or less diffuse, appears early, and is not diagnostic, (b) separation of the surfaces is important, (c) the presence of osseous foci is of prime importance, (d) joint surfaces should be changed, (e) distension of the capsule by fluid or granulations may also be present, and (f) special attention should be directed to the changes of the head which frequently correspond in time to the earliest onset of the disease.

A case of arthrokatadysis (intrapelvic protrusion) of the hip joint is reported by HODGKINSON (80). He reviews the literature and presents one case of a 45 year old woman with bilateral protrusion and known restriction of motion since the age of 18 years. Etiology is considered to be due to faulty ossification of the triradiate cartilage.

Conditions involving the nervous system are also illustrated. In an excellent article on the possible relationship of neurofibromatosis, congenital pseudarthrosis, and fibrous dysplasia, AEGERTER (81) reviews tissue sections from 15 cases of congenital pseudarthrosis, four of the cases having lesions of the peripheral nerves which were diagnosed as neurofibromatosis and ten showing pigmented skin lesions. It is the opinion of the author that the incidence of lesions typical of neurofibromatosis occurring in the presence of pseudarthrosis is too high to be mere coincidence. HEIN and REAVIS (82), on the same subject, give a general discussion.

MATUSEWICZ (83) describes a case of Recklinghausen's disease (neurofibromatosis) in which there was extensive invasion of central nervous system improved by the use of roentgen therapy.

On the other Recklinghausen's disease, hyperparathyroidism, there are four articles. The AMERICAN PRACTITIONER (84) publishes a discussion of "polyosotic fibrous dysplasia" which is felt should be included here. KRAUSS (85) discusses the diagnosis and treatment in general of "generalized fibrous dystrophy"; SINIGAGLIA (86), a case of "osteodystrophia fibrosa cystica"; and COURTY and LEMAITRE (87), an end result of a case of "Recklinghausen's bone disease" treated by removal of an adenoma of the parathyroids.

STRICKER and LUX (88) report the four year result of a case of generalized scleroderma with arthropathy treated by removal of two parathyroids.

TAYLOR (89) reports a rare case of atrophy of the mandible in a 20 year

old white male with overlying scleroderma. History suggest a traumatic etiology. The bone change is believed to be pressure atrophy secondary to the contraction of the skin over the angle of the jaw.

Various authors present their findings in cases of neoplastic bone diseases. The reticulo-endothelioses of bone are discussed by BOLGERT (90), with accounts of the clinical and laboratory findings of Letterer-Siwe disease, Perther-Jungling disease, xanthomatosis of bone, eosinophilic granuloma of bone, and Gaucher's disease. The possible etiologies are mentioned.

A case of xanthomatosis, associated with vertebra plana with multiple deposits in bone and the appearances of vertebra plana of the ninth dorsal vertebra, is described by DAVIES (91). The initial bone lesions are thought possibly to have been tuberculous in nature or due to the separate existence of both tuberculosis and osteochondritis vertebral (Calve, 1928). The steps taken to reach a diagnosis are recorded; the importance of general radiographic examination of the skeleton, in cases showing bone lesions of obscure etiology, is stressed. Attention is called to the value of lateral tomography in vertebral lesions occurring in childhood. References are made to cases reported in the literature in which vertebra plana has occurred in association with the lipoid dystrophies.

A case of Hand-Schuller-Christian disease in infancy is discussed by FALK and PRETL (92) in the light of published cases from the world literature. The symptom complex varies quite considerably at this age from that found in the older child or adult. The first signs of the illness rarely appear before the baby is four months old and then, frequently, consist of some typical skin affection like chronic eczema, purpura, or scborrhoic dermatitis. In many instances, these skin changes constitute a preliminary to some inflammatory conditions, e.g. otitis media, etc. Besides these skin manifestations, one nearly always encounters a swelling of the lymph glands, usually generalized and accompanied by enlargement of the liver and spleen. On the well known tetralogy of symptoms, which is scarcely ever seen in its completeness even in older children, evidence of bony changes alone may be present in the baby later in the course of the illness and, rarely, exophthalmus. The blood cholesterol level is hardly ever raised. The children usually succumb to the disease in a few weeks or months, the immediate cause of death being the profound changes in the lung. On clinical and morphological grounds, great similarity exists between infectious reticulo-endotheliosis (Letterer-Siwe disease) and Hand-Schuller-Christian's disease. In the authors' opinion, pathogenesis and etiology of both conditions belong to one of the allergic reactions (infection allergy). Assuming this allergic hypothesis, it becomes easy to understand why many investigators in recent times have voiced the opinion that the Letterer-Siwe disease is the forerunner or acute form of Hand-Schuller-Christian's disease, terminating fatally in the young baby or infant. The characteristic disorder of lipide metabolism of this condition might also be attributed to an allergic response.

His findings in a case of the Sturge-Weber syndrome (meningeal hemangioma) in a girl of 13 relieved by radiotherapy are outlined by STRANG (93). Outstanding signs of the syndrome are (a) a portwine nevus on one side of the face, (b) calcifications in the occipital region of the brain on the same side, and (c) neurological manifestations due to intracranial lesion.

Jacksonian epileptic attacks are commonly seen rather than generalized seizures, and paralysis sometimes occurs.

BOUCHER and LAPRADE (94) report a case of decalcifying myeloma. This is known also as Kahler's disease, Huffert's disease, Bence-Jones albuminuria, and multiple myeloma.

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CHAPTER III
TUBERCULOSIS

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I. General Considerations

- A. Clinical Aspects
- B. Pathogenetic
- C. Laboratory
- D. Age and Race
- E. Forms and Types

II. Regional Considerations

- A. Head and Trunk
- B. Spine
- C. Upper Extremity
- D. Lower Extremity

III. Therapeutic Considerations

- A. Streptomycin
- B. Streptomycin Experimental
- C. Para Amino Salicylic Acid
- D. Other Inhibitory Agents
- E. Surgical Treatment

General Considerations

SCHALLE (1) in a good general article emphasizes the necessity for early orthopedic diagnosis in bone and joint tuberculosis. Treatment is outlined in detail including mention of PETHEOSTHOR (the Thorium preparation). This is sound, brief, but complete and conservative presentation of what a young general practitioner should know about bone and joint tuberculosis. SZTABA (2) reports clinical findings and statistics on a series of 132 children 1 to 7 years of age with osteo articular tuberculosis.

LOPEZ-VALLEJO (3) refutes the old theory of Marfan that recovery from glandular tuberculosis confers immunity. He cites cases where pulmonary lesions developed 5 - 20 years after glandular lesions have healed, and discusses allergy and its coexistence with immunity. He

quotes statistics of Kirschner on Prussia showing high mortality in the first year of life, decreasing the tenth year, then increasing with age. He recounts his experience with animal and human inoculation with BCG and concludes that in small children BCG confers immunity for two or three months and allergy for three to five years. The allergic state, he believes causes a virulent infection to remain localized. OEHLECKER (4) reviews Koch's work on tuberculosis and discusses laboratory differentiation between human and bovine types, enumerating many causes of false positive findings due to faulty technique. Bovine tuberculosis, he reports, occurs in 4% of adult cases and 2% of children. Bone tuberculosis is frequently more atypical and proliferative by x-ray. SEGHINI(5) reports studies on protein changes in serum in 19 cases of bone tuberculosis. DIAZ-BORDEU (6) recounts sedimentation rate studies in bone tuberculosis and its relationship to generalization and localization of the infection, concluding that its prognostic and diagnostic value is questionable.

EBHARDT (7) presents 5 cases of "benign" bone tuberculosis in aged persons and concludes that even with inadequate treatment, these patients often are able to recover and even heal. SITTERLEY (8) pleads for more facilities for control of increasing tuberculosis morbidity among the aged. ROLLIER (9) offers an illustrated article on the fresh air and sunshine treatment for children and young adults.

SANGIOVANI et al (10) regard cephalalgia as a toxic reaction to tuberculosis of pleura and lungs, quite different from purulent meningitis and simple meningismus. Lumbar puncture performed diagnostically is an excellent therapeutic measure for cephalalgia.

Regional Considerations

ENGLAND and GOLAN (11) give reports of two cases of tuberculosis of mandible. FISCHER (12) details autopsy findings in a woman aged 40 who died after having been known to have lymphogranulomatosis for 9 years. She was found to have cancer of the spleen and lung, and new tuberculosis of lung and hilus nodes.

HERDNER (13) describes 3 cases of tuberculosis of the sternum localized by tomographic x-ray technique. He explains the method of Zimmer which is taking two slightly oblique posterior anterior exposures on the same film moving the tube longitudinally 1cm between exposures. This blurs the shadows of the ribs and vertebrae and leaves the image of the sternum distinct.

MC BURNETT (14) gives a general discussion of the treatment of spine tuberculosis. SORGE (15) stresses the importance of clinical examination in early diagnosis of spine tuberculosis. GARCEAU and BRADY (16) ask for surgical treatment, if 4 months of conservative treatment fails, and quote comparison in 32 cases. KNIEDEL et al (17) report a case of a unilateral TB abscess of the thoracic spine and underscore the importance of the postero medial pleural line as a thoracic landmark in x-ray examination.

SEREE et al (18) compare the results of early bone graft in Potts disease to classical treatment. In 313 cases there were 46 recurrence of which 40 were after early graft. They conclude that it is better to wait

until the period of activity is ended, before grafting and hope that streptomycin or some other antibiotic will shorten the period of activity.

SOUZA-DIAS (19) performed a complete type fusion successfully on a man 38 years old with tuberculosis of sacro-iliac joint.

COLANTUONO (20) reports a case of tuberculosis of the scapula in a woman 52 years of age which had been draining for a year and which was cured by excision. X-ray showed bone erosion and bacterial and histological studies reveals tubercle bacilli. The condition is rare -- 34 cases have been reported but in 26,000 autopsies at the Institute of Pathologic Anatomy in Rome, only one case was found.

KOZLA (21) gives a rather complete discussion of the differential diagnosis of early tuberculosis of the hip and Legg-Perthes' osteochondritis deformans in juveniles.

ROLDAN (22) lauds the symptom of knee cap pain on external rotation and abduction of an early tuberculous cavitis, as a diagnostic sign. ARMANET (23) points out that tuberculosis of the hip soft tissues but not primarily of the joint gives a somewhat different type of picture than ordinary joint tuberculosis. It is usually a simple type of arthritis in young people, mild, completely clearing as focus clears. In patients over 30 years of age it may be more severe but also may clear or may require fusion. Twenty-three cases are reported. JEFFERSON et al (24) find that tuberculosis of greater trochanter is frequently missed by x-ray. Of 105 cases reported in literature, 74% had TB elsewhere in the body. Author had two cases treated by total excision with success.

MARTENS (25) studied eleven cases of tuberculosis of the knee and stresses the difficulties of diagnosis, particularly in children. Diagnosis is made clinically and by x-ray.

KHOO (26) reports a case of tuberculosis of cuboid and tarsal bones.

Therapeutic Considerations

In an early report on streptomycin, BOSWORTH et al (27) were especially optimistic in cases with draining sinuses, not so much so with closed lesions. MILLER et al (28) treated two cases of tuberculous tenosynovitis on an out patient basis successfully with streptomycin and immobilization. SMITH and YU (29) give a detailed report of the results of streptomycin combined with surgery in 28 cases of joint tuberculosis. They observed a remarkable influence of the drug on the course of the disease. There were three failures. JONES and HOWARD (30) reduced the death rate in children from 15% to 1% in 101 cases of tuberculosis treated with streptomycin. ARONOVITCH and LEWIN (31) offer another early paper on the subject. CAWLEY (32) reports a case of intrathecal streptomycin for tuberculous meningitis, with recovery.

MARINO-ZUCO (33), HUWYLER (34), GERARD-MARCHANT (35)(36), ECHEVERRI (37), ARANDA DE ROJAS (38), ALLENDE et al (39), and TREMBLAY (40) report on the success of streptomycin and PAS in the therapy of osteo-articular tuberculosis. All agree it is useful. KUTZ et al (41) report

two cases of cystic tuberculosis of bone complicated by tuberculous meningitis which healed with streptomycin and promizole.

Experimental work with streptomycin was done by OGINSKY et al (42). They state that it specifically inhibits an oxidative reaction in susceptible strains of E. Coli. This reaction is apparently the "oxalacetate-pyruvate" condensation and when inhibited prevents a variety of substances from entering the terminal respiration system that resembles the citric acid cycle. BOGEN (43) urges minimal effective doses, i.e., 0.4 gms. per day to lessen danger of development of resistant strains. ADCOCK and Associates (44) studied absorption and excretion and state that streptomycin combines with para-amino-salicylic acid in ratio of 1 g. to 0.8 g. respectively to form paraminosalicylate which when injected IM is only slightly more irritating than an equivalent dose of streptomycin. Plasma and urine levels showed the peak of streptomycin 60-120 minutes after injection, and the PAS peak in 15-30 minutes, but when injected together, levels are lower.

TURKISH and MURPHY (45) report the 18th proven case of osteitis tuberculosa multiplex cystica, a 19 month old negro, male, and its recovery with streptomycin and PROMIZOLE. The advantages of using PAS with streptomycin was studied by HOBBY et al (46) in mice with experimental tuberculosis. CARR and HINSHAW (47) treated 35 patients with dihydrostreptomycin and found less neurotoxicity and equal benefit.

GOODACRE and SEYMOUR (48) tried to induce resistance to streptomycin and PAS in 25 strains of Mycobacterium tuberculosis, one strain developed resistance after four months.

In a study of PAS blood levels, DYE and WEISER (49) find that 10.8 g or more of PAS at 3 hour intervals maintain a free PAS level of 10 micrograms per milliliter of plasma after two weeks therapy which is a level that inhibits the resistant variants as well as the large mass of the bacterial population.

RODRIGUEZ (50), ZIFRONI (51) believe streptomycin more effective with PAS. TAPIE et al (52) discuss toxic reactions of PAS, nausea and vomiting is rare. One case developed fever and neck pain on two different brands of PAS even without streptomycin. SAMITIER (53) discusses inhibitory agents and argues PAS requisite.

KARLSON et al (54) show neomycin less effective than streptomycin against experimental tuberculosis in guinea pigs.

PAOLETTI (55) experimented on the action of pancreatic extract treated with 24 normal sulphuric acid and concluded that it may kill tubercle bacilli after 24 hours of contact.

BURNS et al (56) treated 24 tuberculous broncho pneumonia patients with PROMIZOLE without favorable response.

MILLNER and HURST (57) treated 30 with NEO-ANTERGAN and PHENERGAN (antihistaminics) for several months with slight improvement.

BRANDT (58) used Petheostor a preparation of Thorotrast. Thorium

X has a half life of 3.6 days but Thorotrast has 25% Thorium oxide which has a half life of 25 million years. Fuermaier began to use it in 1944 and reported 20 cases in 1949. In no case did it effect menstruation or sperm count but the lay press gave it deplorable publicity. His own series of 11 cases had an average of 30 injections of Peteosthor. It did not seem to shorten the duration of any case of osteoarticular tuberculosis nor is it felt that it had any direct or specific influence on the infection.

GRUCA (59) describes an excision of quiescent tuberculosis of the hip, an operation designed to give a stable and freely moveable pseudarthrosis.

McCOMAS (60) gives a review of 88 TB hips, 33 of which were treated surgically. Late results of 23 fusions showed 16 good. He prefers the Ghormley type of fusion with the Wilson graft.

GYARMATI (61) reviews the surgical procedures of Mundblick, Westermann, Multanowazky, Harris, Haas, Schreiner, Adelberg, Johnson, Weldenstrom, Calv Key, Gill, Anderson, Orell, Badgley, Hammond, Brittain, and Soviet Union surgeons. LUKANOV (62) describes shoulder arthrodesis using the outer half of the clavicle as a graft, and knee arthrodesis dovetailing the femur into the tibia. OTERMIN-AGUIRRE (63) reports the case of a 19 year old girl with tuberculosis of the elbow of two years duration who was treated by resection and streptomycin, and who healed in five days three years previously. WEIL (64) compares advantages of open ischiofemoral arthrodesis, quoting Van Gorder and Trumble, and prefers it to the methods of Brittain of driving the graft in blindly and of Voley of osteotomizing the femur.

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CHAPTER IV

MISCELLANEOUS SUBJECTS

By

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- I. General progress
- II. Wound healing
 - A. Delayed suture
 - B. Wound rupture
 - C. Grafts
 - D. Tissue reactions
- III. Peripheral vascular conditions
 - A. Patho-physiology
 - B. Arteriography
 - C. Collateral circulation
 - D. Thrombosis
 - E. Gangrene
- IV. Miscellaneous
 - A. Occupational therapy
 - B. Calcium and phosphorus content of the diet

There have been 19 articles abstracted for this chapter which are considered to be among the best of the 262 titles selected as "Miscellaneous Subjects." The majority of them have to do with wound healing and peripheral vascular conditions.

General Progress

Significant recent advances are reviewed by O'BRIEN (1) and, in essence, are antibiotics, epiphyseal stapling, bone bank, the vitallium cup, femoral head prostheses, and the intramedullary nail.

Wound Healing

Delayed suture in the management of 721 traumatic wounds is analyzed by LOWRY and CURTIS (2). They report that, when suture was accomplished four to six days from the initial debridement, no undermining, trimming or excision was necessary, and 97.4 per cent of the wounds in this group (19 per cent were so treated) healed. When the interval was seven days or longer, undermining and excision of wound edges was necessary, and only 86.7 per cent healing was obtained (68 per cent were so treated). In 12 per cent in which excision en masse was used, there was 91 per cent healing. The authors conclude that healing occurs in over 90 per cent when suture is accomplished

between the fourth and seventh days and that the optimum time interval is at the fourth or fifth day.

The cause of wound rupture in 61 cases out of 12,786 celiotomies is reviewed by LANDRY et al (3). Age, sex, season of the year, the particular surgeon, hypoproteinemia, suture material, use of a drain, type of anesthesia, and contamination of the wound have little bearing on whether the wound ruptures or not. The striking factor is the high incidence of cough, abdominal distention, vomiting, and urinary retention during the postoperative course of wound rupture cases, 95 per cent to be exact. It is the authors' belief that these and other causes of increased intra-abdominal pressure prevent the effective repair of the wound. (Ed: Although wound rupture is not a major problem of orthopedic surgery, this article is included because of the evidence of the effect of internal pressure on wound healing.)

Various full thickness pedicle grafts and their indications are discussed by MARTIN and BRAUER (4) in respect to replacement of unstable scar tissue and in preparation for bone or tendon surgery in the lower extremities. Simple closure and split thickness grafts usually suffice over soft tissue defects; however, when the defect is over bone or tendon, pedicle tissue usually is required. The double pedicle is useful in linear defects of the upper two-thirds of the leg when the secondary defect does not occur over the tibia, popliteal space, or Achilles tendon. A local flap is useful where the double pedicle is not feasible and usually only about the knee where the circulation is excellent. Cross leg calf grafts are valuable when a graft is necessary from a distant area. A cross open thigh flap to the opposite distal one-third of the leg is highly useful when large amounts of tissue are needed. An open abdominal flap graft can be used in selected cases, when mechanically practicable, by migration via the forearm for covering of very large defects. Also in large defects, particularly when bone substance is missing, an abdominal tube graft is applicable since the fat carried with it is available to aid in rounding out the bone defect. This graft is migrated to the lower extremity by first attaching it to the wrist. Each case is an individual matter, but, in view of the speed and simplicity of an open flap graft, this method should be employed whenever possible.

Successful take of skin grafts are given by LEWIS (5) as: an aseptic base, adequate blood supply in the recipient area; correct timing, three to four weeks after burns; a clean, firm, cherry red and not too exuberant, granulating surface; and good general conditions (no anemia). The graft must be held firmly in contact with the recipient area by the use of sea sponges, mechanic's waste, or wax stents, which are left in place for four to nine days. In 27 cases of transplantation from one person to another, 100 per cent failure is reported. If insufficient skin is available, twice the area can be covered by cutting the graft into postage stamp squares, placed one centimeter apart in checker board fashion.

Tissue reactions, specifically chlorophyll and wound healing, is the subject of an experimental and clinical study by LAM and BRUSH (6). In their experiments with 102 guinea pigs, the control wounds healed in an average of 10.2 days, while the chlorophyll treated ones took nine days. In the graft site experiments on five patients, all wounds healed in 10 days. In the burn cases, using chlorophyll on one side and vaseline gauze on the other, no favorable effect of chlorophyll was evident. In the ulcer cases,

healing time was slightly shorter when chlorophyll was not used. The authors conclude that in no instance was a favorable effect produced by chlorophyll.

The effect of dicumarol on wound healing is the subject of experiments by TAYLOR and ZIPPERMAN (7). The method of direct observation and histologic study is used in wounds made in dogs. When the prothrombin levels are kept at 10 per cent or less, there is a definite tendency on the part of the experimental wounds to bleed with the result that hematomata develop. These definitely weaken the wound and delay healing. When the bleeding in the experimental wound is controlled, no detrimental effect of dicumarol on the healing rate is noted.

Radiation injuries of the skin are analyzed by TELOH et al (8) in 215 specimens removed from 121 individuals with postradiation dermatitis. Changes noted in the epithelium after irradiation are atrophy, acanthosis, hyperkeratosis, and, occasionally, parakeratosis. Dysplasia of the epithelial cell is felt to be a stage in the formation of the carcinomatous lesion. Vascular changes in postirradiation dermatitis consists of alteration of the endothelium, degeneration of the media and adventitia, perivascular lymphocytic infiltration, and occasional thrombosis. The end product is marked endothelial proliferation with decrease of the lumen and fibrosis of the media and adventitia. Stromal changes, which are non-specific, are partly the result of inflammatory response to irradiation and partly due to the vascular change with ischemia. The hair follicles and sebaceous glands are extremely sensitive to radiation injury. The sweat glands are found to be the most resistant structure to irradiation injury, but they undergo various stages of atrophy and are an excellent index of the degree of irradiation injury. In the 121 individuals with irradiation damage, malignant changes are seen to occur in 28.1 per cent. Malignancy is found usually to be localized by the stromal barrier. The fundamental biologic behavior is, however, identical with that of any squamous cell carcinoma of the skin.

Tantalum mesh is strongly advocated by KOONTZ and KIMBERLY (9) for closing defects in the abdominal wall due to hernia. It is very well tolerated by the body with fine fibrous tissue laid down about it. If exposed to the peritoneal cavity, it becomes covered by fibrous tissue and peritoneum. The mesh will not migrate and will not interfere with growth when used in young puppies. Infected wounds heal well with the mesh in place.

Peripheral Vascular Conditions

The patho-physiology and treatment of the lower leg stasis syndrome is discussed by BAUER (10) in an outline of the physiology of leg vein return circulation in conjunction with an explanation of the rationale of popliteal vein division and resection for cases of chronic edema, induration, and ulceration of the leg. The importance of a "peripheral heart" action of the calf muscles is described as a factor in the venous stasis syndrome. Thus, a possible means of overcoming venous stasis is by eliminating the backflow of large, aavalvular trunks by resecting same and, thereby, forcing the return flow through collateral venous channels with functional valves. Hence, the efficacy of popliteal vein resection in these cases where the valves have been destroyed by thrombosis or phlebosclerotic processes is shown, and it is stated, and clinically well verified, that after this oper-

ation the calf muscle contractions drive the blood through numerous fine-calibered channels into the muscle veins of the thigh, and that no backflow can occur.

The arteriography of the lower extremity is reviewed in detail by CAMPBELL and SMITH (11). The technique, indications, contraindications, complications, benefits, and advantages are given. Two important contraindications mentioned are deformities which make x-rays difficult and sensitivity to the contrast material. Arteriography is a distinct aid in determining the site of a proposed amputation and in selecting suitable candidates for lumbar sympathectomy. A specific indication, in a small number of cases of segmental occlusions in major vessels requiring repair by vein grafts, is also mentioned.

Collateral circulation in the presence of experimental arteriovenous fistulas in dogs has been measured by ROBERTSON et al (12). They conclude that the policy of delay in the treatment of an arteriovenous fistula to allow for the maximal development of collateral circulation is sound and is supported by their experiments.

Varicose veins, according to PRATT (13) as seen in his clinic, usually require surgery. Only about 10 to 15 per cent of the patients are proper subjects for injection treatment alone. Surgery consists of (a) resection of each branch of the greater saphenous vein in the groin with resection of a three inch portion of the vein itself and ligation flush with the femoral vein, (b) a wide resection at each incompetent point with ligation of each perforating vein, (c) resection of the lesser saphenous vein at the popliteal insertion, and (d) stripping of the veins between the groin and each incompetent point. Causes of failure in simple varicose vein therapy are discussed.

Venous thrombosis is discussed in articles by PRATT (13) as well as by OCHSNER et al (14, 15). Thrombophlebitis is defined as an inflammation of the wall of a vein with a secondary clot, firmly attached, infrequently detached and then only with suppuration and liquefaction. Symptoms are severe, with pain, fever, and swelling. Phlebothrombosis is defined as the formation of a loosely attached clot which may be easily detached. The predisposing cause is alteration in the blood, favoring coagulation, the result of tissue injury. The precipitating cause is circulatory stasis and is combated by early ambulation, active muscular contraction against resistance, compression bandages to accelerate deep venous flow, and deep breathing to assist venous return to the heart. Anticoagulants are dangerous because of the hemorrhagic tendency they produce. In addition, constant vigilance for early development of phlebothrombosis and prompt thrombectomy and ligation, are indicated. Phlebothrombosis occurs when the antithrombin level of the blood is proportionately lower than the prothrombin. It is diminished in most post-operative cases and usually returns to normal in four to five days. If the proportion is less than 1:16, phlebothrombosis is possible. Alphatocopherol and calcium are effective.

Gangrene as a complication of venous thrombosis is reviewed by HAIMOVICI (16), and cases are reported. Gangrene usually remains superficial and limited, and a conservative surgical approach to the condition is recommended.

A case of ischemic necrosis of the anterior tibial muscle is contri-

buted by TILLOTSON and COVENTRY (17). Since 1943, six other similar cases have appeared in the literature. In the case cited, the authors report onset of pain and swelling of the leg following a four mile hike, patient developing foot-drop five days later. They describe treatment consisting of transplantation of the peroneus longus into the middle cuneiform. Biopsy of the anterior tibial is said to have shown avascular muscle with fibrous tissue, inflammation and necrosis, fragmentation, loss of striations, and edema. Pathogenesis is considered to be a reflex spasm of the anterior tibial artery due to retention of lactic acid incident to muscular fatigue, producing anoxia and eventual necrosis. Recommended treatment consists of early recognition, splinting, slight elevation, papaverine, paravertebral block, or arterectomy, all within twelve hours of onset.

Miscellaneous

What every physician should know about occupational therapy is grouped by LICHT (18) under five headings as follows: (a) remedial exercise, (b) graduation of exercise, (c) improvement of tonus, (d) influence on the mind, and (e) evaluation. (Ed: This is an interesting and readable article.)

The effect of the calcium and phosphorus content of the diet upon the formation and structure of bone is illustrated by CARTTAR et al (19) in experiments with 141 rats. Animals on "adequate" (0.2 per cent Ca) diets show short metaphyses indicating inadequate calcium storage, great osteoblastic and osteoclastic activity indicating maximum utilization of calcium, osteoid borders on trabeculae indicating poor storage of calcium, and a porous shaft as in very young animals. On "optimum" (0.8 per cent Ca) diets, there is maximum calcium storage, maximum calcium utilization, maximum calcification of trabeculae with no osteoid, and a very dense shaft as in adults. On high calcium diet (2.0 per cent Ca) with no phosphorus increase, there are osteoid trabecular borders, diminished depth of calcification of the epiphyseal cartilage, retardation of invasion, removal of the epiphyseal cartilage, and a rachitic metaphysis.

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CHAPTER V

RESEARCH

By

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- I. Endocrine system
 - A. Steroids
 - B. Other conditions
- II. Tissue growth
 - A. Requirements
 - B. Tissue extracts
 - C. Vitamin deficiency
 - D. Miscellaneous
- III. Vascular system
 - A. Anatomical
 - B. Clinical research
 - C. Serum electrolytes
- IV. Nervous system
 - A. Temperature regulation
 - B. Anaesthesiology
 - C. Embryology
 - D. Miscellaneous
- V. Muscular system
 - A. Strength and spasm
 - B. Physiology
 - C. Biochemistry - metabolic
 - D. Biochemistry - physiological
 - E. Muscle relaxants
- VI. Skeletal system
 - A. Osteogenesis
 - B. Anatomy
 - C. Biochemistry
- VII. Miscellaneous

There were 157 articles submitted for abstracting in this chapter, but due to various reasons, only 69 were received. These abstracts were omitted mainly because they were worthless.

Endocrine System

Four articles follow on the subject of steroids. The influence of hyaluronidase and steroids on permeability of synovial membrane is reported by SEIFTER et al (1), who found the permeability of the synovial membrane as measured by speed of absorption and excretion into the urine of phenol-sulfonphthalein (PSP) instilled into the joint to be surprisingly constant in a group of 16 rabbits. Hyaluronidase markedly increased permeability of the synovial membrane. The effect was maximal and was not augmented by desoxycorticosterone. Adrenal cortical extract decreased permeability of the synovial membrane and antagonized the effect of hyaluronidase. Desoxycorticosterone increased maximally the permeability of synovial membrane to the same extent as hyaluronidase and could not be augmented by hyaluronidase.

The physiological effects of cortisone and ACTH in man are reported by SPRAGUE et al (2). Clinical and metabolic studies of 33 patients who received cortisone or ACTH were studied. The greatest number of these cases were rheumatoid arthritis. The studies were concerned chiefly with the prolonged administration of the hormone. The capacity of cortisone when administered in sufficiently high dosage for a protracted period to induce most of the clinical and metabolic features of Cushing's syndrome was demonstrated. The features so induced in varying combinations included rounding of the facial contour, hirsutism, acne, keratosis pilaris, muscular weakness, edema, amenorrhea, cutaneous striae, mental depression, impairment of carbohydrate tolerance, negative nitrogen balance, increased excretion of corticosteroids in the urine, hypochromia, hypopotassemia, alkalosis, and negative potassium balance (in some cases). ACTH caused disappearance of eosinophils.

HOWES et al (3) state that cortisone (compound E) retards the formation of granulations. It also slows, but does not stop, epithelialization. These observations have been made on man and on two different laboratory animals.

The PROCEEDINGS OF THE FIRST CLINICAL ACTH CONFERENCE (4) is reviewed. The drug is said to have an effect on eosinophil count, hypertension, leukemia, lupus erythematosis, periarthritis, and all collagen disorders. Benefit from its use is found in glandular disturbances, several personality disorders, mental depression, delirium tremens, and possibly other conditions which are being investigated. The importance of rapid dissemination of good well-controlled scientific data as is done in this book and the various reactions to the medical progress brought about are discussed. It is felt that diabetes is a minor complication, if any, to the prolonged administration of the drug.

Two articles are abstracted on other conditions of the endocrine system. The influence of sex hormones on tolerance to aminopterin is discussed by WEINTRAUB et al (5). Folic acid synthesis by intestinal flora decreased the toxicity of aminopterin in mice on an otherwise folic acid deficient diet. The addition of 10 per cent succinylsulfathiazole to the diet gave more consistent results though aminopterin tolerance was lowered.

The results of adrenal function tests in chronic polyarthritis are given by COSTE et al (6). Thorn's haematological and metabolic adrenaline tests yielded very much the same results in polyarthritic, spondylarthritic,

and control subjects. The significance of Thorn's test is doubted. It is considered necessary to determine whether adrenaline influences the number of eosinophils in the blood and the excretion of urates only via the adrenocortical route, which is probable but has not been proved. On the other hand, the fact that eosinophilia could be produced by means of various stimulants (injection of gold salt, normal serum, etc.) indicates that the haematological test is very sensitive. This does not decrease its value but it affirms Selye's theory of the extreme commonness of adrenocortical alarm reactions and their production by numerous and highly variable factors.

Tissue Growth

Requirements for tissue growth is the subject of three articles, in one of which STEARNS (7), considering human requirements, points out that calcium, phosphorus, and magnesium are usually considered together from a nutritional point of view, because all three occur in bone, and with carbonate, make up the major part of bone mineral. Ample evidence exists that deficiency of intake or utilization of these minerals results in slowing of growth and lengthening of the growth period; it is possible that such deficiencies in adult life may hasten senescence. Milk has considerable calcium and when it is drunk increases growth. Nearly all foods contain ample phosphorus and magnesium.

EDEN and SELLERS (8) recount their findings regarding the absorption of vitamin A. Four hours after the administration (orally) of vitamin A esters, almost complete hydrolysis had occurred in the intestinal lumen of some bovines, whereas in others hydrolysis was only partial. Examinations performed on the intestinal mucosa at the same time showed that about 75 per cent of the absorbed vitamin A was in the ester form, and the same was true in animals dosed with vitamin A alcohol. The results indicate that the intestinal wall is capable of esterifying free vitamin A alcohol, but so far no evidence could be obtained that the esterified vitamin A is absorbed in its unaltered form.

MARGOLIASH (9) reports on tissue extracts and he found that when several acetone fractions of adult chicken heart extract were prepared and their growth-promoting power tested on 3rd passage culture of fibroblasts derived from eight day old chicken embryo hearts, the acetone precipitate possessed less than 25 per cent of the growth-promoting activity of the original extract. Protein denaturation occurring during precipitation was not the cause of loss of activity. The acetone-soluble fraction of the heart extract contained no growth promoting activity. Combination of the two fractions resulted in a restoration of the full growth-promoting activity of the original heart extract. It is suggested that these results support previous reports that "the in-vitro cell growth-promoting effect of adult tissue extracts depends on at least two factors or two series of factors acting together to produce the total effect."

MEITES (10) reports that diethylstilbestrol and the natural estrogens depressed the growth rates in 70 normal rats. It was shown that this was due mainly to its ability to depress appetite in the case of the diethylstilbestrol while the natural estrogens had less effect on the growth rate and did not decrease food consumption. Larger doses of the diethylstilbestrol gave greater growth inhibitory effects.

GERSH and CATCHPOLE (11) report an extensive study of the organization of ground substance and basement membrane and its significance in tissue injury and disease. Ground substance of connective tissue and the homogenous component of the basement membrane are closely related substances. They contain glycoproteins which form a fluid to gel-like medium. They infiltrate and enclose a network of oriented fibrils or fibers and it is suggested that ground substance including basement membrane is polymerized and presumably structurally organized on a submicroscopic level and that this polymerization varies depending on age, activity, and degree of pathologic change. Chemical and physiological properties are defined and morphological evidence is given of changes occurring in permeability of blood vessels, growth of neoplasms, spread of metastases, and in certain endocrine glands, cartilage and bone.

BALCHER and LICHSTEIN (12) report a study of effect of homobiotin and norbiotin on yeast. They present data to show that, although homobiotin and norbiotin exhibit antibiotic activity against certain strains of yeast, for others these compounds may replace biotin for growth.

Vitamin deficiency is the subject of two articles. In one of these articles, MURRAY and KODICEK (13) found that when guinea-pigs were subjected to total deprivation of vitamin C they showed classic changes and since the proximal ends of the tibial diaphyses were destroyed by repeated microfractures, the epiphyses came to overlap, the narrow zone of the tibial shaft now in contact with it, both laterally and medially. The damage to the epiphyses was usually greater medially than laterally, making the animal bow-legged. When the animals, in which these changes had occurred during a period of total deficiency, were again given the vitamin, reparative changes restored the tibia to a form approaching the normal. These changes were: (a) the formation of a subperiosteal thickening in the widened periosteal cambium which filled the angle between the overhanging epiphyses above, the fibrous layer of the periosteum and the old diaphyseal wall, (b) the formation around the proximal end of the diaphyses of cartilage derived from the periosteum, and its later replacement by endochondral bone which was added to (c) a trabecular bone formed endochondrally at the growth cartilage. All these changes occurred in some cases, but not in all and there was great variation in detail.

Joint lesions in acute and chronic scurvy are reported in growing and young adult guinea pigs by PIRANI et al (14). The incidence and severity of haemorrhagic arthropathy declined in chronic scurvy. Whereas intraarticular lesions may improve spontaneously, periarticular changes are less prone to regress even after therapy. Periarticular fibrosis seems to be responsible for the persistent functional impairment in scurvy. The scorbutic lesions are different from those seen in rheumatoid arthritis and rheumatic fever.

Under miscellaneous CRAWFORD (15) presents the results of an experimental study of tendon growth in the rabbit. Small India ink marks were made at intervals along the length of tendons in the limbs of young rabbits and the distance between the marks was measured during the operation. The rabbits were killed two to three months later, and the amount of longitudinal growth that had occurred was determined by remeasuring the distance between the marks. The experiments showed that the whole of the tendon grows

interstitially in length, but that maximal growth occurs near the muscle tendons junction. The marking did not seem to interfere with the tendons.

Vascular System

One article by FERGUSON (16) on anatomical considerations makes some observations on the circulation in foetal and infant spines. A step has been taken toward the classification of the arterial circulation of the spine. 24 foetal and infant spines were studied. The pedicles, transverse process, articular facets, and laminae have a good arterial blood supply through the anastomosing branches of the posterior rami from the paired segmental arteries of the thoracic and abdominal aortae.

Two articles are reviewed on clinical research. Investigating for the eosinophil response to surgical trauma, COPPINGER and GOLDNER (17) find that individuals with normal adrenal cortical function show a fall in the number of circulating eosinophils following surgical trauma. The degree of fall is directly related to the length and severity of the trauma and the time interval required for recovery is longer after the more serious procedures. Elderly individuals show a more marked depression and delayed recovery than do young individuals. Preoperative and postoperative complications produce and maintain a fall in the circulating eosinophil level.

JACOBS and RAFEL (18) report a comparative study on a microscopic basis of absorbable hemostatic agents - fibrin foam, gelatin sponge (gelfoam), and oxidized cellulose. From this study, using the sockets of extracted mandibular teeth of a dog, an attempt has been made to determine the degree of absorbability of the materials, their effect on bone and soft tissue healing and the inflammatory responses to them. It appears that fibrin foam disappears first and that oxidized cellulose remains longest. The method of disappearance of the substances is not known but phagocytosis by giant cells, leucocytes, and the presence of lytic substances appear to play a role. Epithelialization is not significantly altered by fibrin foam while cellulose and gelatin sponge retard it.

Three articles are included on the subject of serum electrolytes. POPOVICI et al (19) report on the experimental control of serum calcium levels *in vivo*. The ability of ethylenediamine tetra-acetic acid to form undissociated calcium complexes at physiological pH was utilized as a tool to regulate available serum calcium levels *in vivo*. Further evidence has been presented for the regulatory action of magnesium ion on serum calcium levels.

In an article entitled "Electrolyte Problems in the Surgical Patient, with Particular Reference to Serum Calcium, Magnesium, and Potassium Levels," MARTIN et al (20) report that serial determinations of serum calcium, magnesium, and potassium levels were performed in six patients with nasogastric suction who were receiving only intravenous fluids. A drop in the serum calcium, magnesium, and potassium occurred in each patient. One patient developed tetany. The magnesium was lost in the urine. The loss of potassium was found in alkalosis, prolonged nasogastric suction, prolonged use of paracentral fluids without potassium, and in fistulae and diarrhea.

Variations in the protein-bound Ca in the blood (as determined by an unpublished personal method) are of interest in the diagnosis of certain

diseases, state HOCHFELD and HOCHFELD-OLLIVIERO (21). Attention is drawn to the idea of diffusible Ca, represented by the difference between total and protein-bound Ca. The following were studied in turn: (a) effects of synthetic oestrogens and testosterone implantations on the blood Ca, (b) hypercalcaemia induced by injection of Ca gluconate, and (c) hypocalcaemia induced by intravenous injection of citrates. The variations of the diffusible and protein-bound Ca fractions were studied in all of these cases.

Nervous System

Under temperature regulation, HILL and RUTLEDGE (22) report effects of large molecular and particulate substances on body-temperature of rats. India ink, suspensions of blood charcoal, carmine, and trypan blue were injected subcutaneously and intraperitoneally. Carmine was also injected intramuscularly. After subcutaneous and intramuscular injection a rise in body temperature was observed.

SONNENSCHEIN and IVY (23) report a failure of oral antipyretic drugs to alter normal human pain thresholds. It is suggested that either our concepts of antipyretics as analgesics is in error or our methods for determining sensitivity to pain are inadequate. Subjects tested by electrical stimulation of the tooth showed no greater increase in thresholds when given acetanilide, aminopyrine, phenacetin or aspirin than when given lactose. Similar results were given by a modified Hardy-Wolff-Goodell radiant heat test. Untreated controls showed no statistically significant changes. The decrease in pain noted with placebo or drugs is ascribed to psychic factors or to the action of these substances upon the pathological processes which cause pain.

Anesthesiology is the subject of two articles, one of which is reported by POULSEN and SECHER (24) who state that stimuli supramaximal for direct muscle nerve preparations in the unanesthetized animal invoked little if any response during ether anesthesia. The injection of 0.007 - 0.18 milligrams/kilogram "neostigmine" (Prostigmine) intravenously inhibited the effect of ether on muscle contraction. It is suggested that ether affects the function of the motor end-plates.

BROWN (25) in reviewing the advances in anesthesiology remarks that the development of modern technics and less toxic analgesic drugs makes it possible for the anesthesiologist, after proper evaluation of the patient by clinical and laboratory methods, to administer any anesthetic drug or combination of drugs by a technique and in a concentration that will least disturb the normal human economy under any surgical procedure. This also involves chemotherapy and proper replacement therapy with fluids, electrolytes, blood, and blood fractions.

There is only one article on embryology and it is written by WATTERSON and SPIROFF (26) who discuss the factors responsible for the development of the "glycogen body" in the roof plate of the chick spinal cord at the level of spinal nerves 26-29 by unilateral and bilateral leg-bud extirpation. The lateral motor columns are extremely hypoplastic after unilateral leg-bud extirpation and may be completely lacking on both sides in cases of bilateral leg-bud extirpation. There is a definite reduction in length of the glycogen body following both unilateral and bilateral leg-bud extirpa-

tion. The glycogen body is asymmetrical following unequal reduction of the periphery on both sides. There is little, if any, reduction in volume of the glycogen body prior to 15 days of incubation, but there is a suggestion that after the 15th day its volume will be smaller in operated than in normal embryos. This is perhaps correlated with a change in the growth characteristics of glycogen body at about the 15th day. Since reduction of the periphery exerts so little effect upon the development of the glycogen body, the causal factors which control this development, if they reside outside the neural tube, must lie close to the latter. The size of the glycogen body level of the cord appears to control precisely the size of the adjacent vertebral canal. This control cannot be due to mechanical pressure alone, since the size of the vertebral canal greatly exceeds that of the contained spinal cord in the lumbosacral region. The shape of the vertebral canal is determined to a considerable extent by the shape of the spinal cord at the glycogen body level, again by factors acting over some distance.

Under the heading of miscellaneous has been placed an article by BURGEN et al (27) who state the effect of botulinum toxin on isolated rat phrenic nerve diaphragm preparation is that of an irreversible paralysis. The toxin presumably attacks the motor nerves after it has lost its medullary sheath entering the end plate.

Muscular System

Strength and spasm of the muscular system is the subject of four articles, the first of which by WAKIM and GERSTEN (28) reports the studies of objective recording of muscle strength. Data were collected on 20 young women and four men. Repeated observations over a period of weeks indicated there were only slight variations in muscle power for any one individual. Tests were performed in the recumbent position and footboards were used to prevent slipping. Muscle power in forearm flexion averaged 28.05 pounds greater with use of the footboard. Muscle power of the forearm flexors was greatest when the angle at the elbow was between 80 and 90 degrees, and declined when the angle was increased or decreased beyond this range.

KUGELBERG and PETERSEN (29) describe and discuss the insertion potentials found in electromyography of normal, denervated, and dystrophic muscles.

HARELL et al (30) discuss the problem of spasm in skeletal muscle, which is a reversible state of sustained involuntary contraction accompanied with muscular shortening and associated with electrical potential changes. Groups of patients with various types of low back pain, fractures, and poliomyelitis have been examined carefully for the existence of muscular spasm using electromyographic technics. Only in an inconsequentially small number could such spasm be detected. It is believed this diagnosis is erroneous many times. A strong plea is made for thoughtful use of the term spasm differentiating it carefully from spasticity, tonus, contracture, cramp, and rigidity.

CLARKE et al (31) report a study of the amount of muscle strength that may be applied for the same movement of a joint when the body is in different positions and the amount of muscle power applied throughout the range of movements of each joint. Graphs made of the muscle power throughout the range of movements of joints reveal that extension of the hip and of

the elbow produce a descending curve. Ascending curves were produced by extension of the knee, forward flexion of the shoulder, and abduction of the shoulder. The first two motions produced steep curves and the last two produced curves with plateaus. Flexion of the elbow, adduction of the shoulder, extension of the shoulder, and extension of the knee produced an ascending descending curve.

Physiology of the muscular system is the subject of six articles. GORDON and PHILLIPS (32) demonstrate the separation of the slowly contracting deep component and rapidly contracting superficial components of muscles. They have compared isometric twitches of the slow part of the tibialis anterior in cats with those recorded from the whole muscle in the same preparation. The slow part gives simple twitches with a crest time of 25-34 milliseconds. Twitches from the whole muscle show a sharp initial crest at 18-23 milliseconds, with a hump during relaxation which corresponds to the crest time of the slow component.

The resting tension of isolated muscles is measured by HILL and PARKINSON (33) with a strain gauge with a sensitivity of about 10 milligrams. It was found to be zero below about 60 per cent of natural length.

HILL (34) reports above 65 per cent of its natural length the latent period of a toad's sartorius is constant, showing that the muscle does not lengthen in relaxation. For this experiment the muscle must be free of any load because a slight force draws it out after contraction.

KATZ (35) writes on the speed of action and the power of muscles, presenting one of the more interesting problems of physiology, the ultimate explanation of which will depend upon a thorough knowledge of the contractile material and especially of the physical and chemical properties of the long chain protein molecules embedded in muscle fibers.

Two forms of myography are presented by GORDON and HOLBOURN (36) which permit the simultaneous recording of the contractions and the action potentials of single motor units. The experiments are performed on the crureus (stimulated by stretch reflex or by crossed extension reflex) and the tibialis anterior muscle (stimulated by the spinal flexion reflex) of decerebrate cats. The average contraction time (measured from the origin of the twitch to its peak) for single twitches in the crureus is 60.9 ± 1.18 milliseconds, in the subcutaneous fibers of the tibialis anterior 28.9 ± 0.65 milliseconds, and on the deep and distal surface of the same muscle 62.6 ± 1.63 milliseconds. Thus this latter muscle similarly to extensor muscles, contains a mixture of superficial quick and deep-slow fibers. A single motor unit under the influence of very slight reflex excitation, gives single isolated twitches. Usually, however, there is a greater or lesser fusion between individual twitches. No complete tetanic fusion of the twitches of a single motor unit was observed, partly owing to the small stimuli; but there is a complete fusion of two twitches when the motor neuron gives a double discharge, occurring mostly at the beginning of a reflex contraction. The total tension developed in this case is rather more than twice the tension of a single twitch. Clearly, this double discharge allows a large development of tension.

ZINGONI (37) discusses fluctuations in excitability of muscle by means

of an inductor with Kronecker slide or an electronic stimulator, with non-polarizable electrodes; the isolated gastrocnemius of the frog was stimulated liminally or just supraliminally. Rhythmic contractions of low frequency (40 per minute) were observed. It was noted that the height of the individual muscle twitch varied considerably in most cases. These fluctuations disappeared after curarization but persisted after paralysis or degeneration of the motor nerve.

In the study of metabolic biochemistry, HERMANN et al (38) report the fact that there is a greater adenosinetriphosphatase activity in developing muscles than is warranted by the increase in myosin proteins. They homogenized the muscle of rat embryos and fetuses and fractionated this into four parts. One fraction was found to have the purest preparation of myosin and the ATP activity was noted to be six times greater in this than in the other fractions.

CASPE et al (39) state that 41 urinary creatine-creatinine determinations of 34 diabetic clinic subjects show that these excretions were increased as compared with normal controls. Those diabetics with fibrillary muscular activity manifest an average creatine index more than 37 times that of the normal controls. This marked increase in creatine excretion appears to be a part of the diabetic syndrome. The extent of this increase seems to correspond to a condition of muscular degeneration.

MINOT and GRIMES (40) show that urinary excretion of pentose and phosphorous-containing complexes occurs in nutritional muscular dystrophy produced by a vitamin E deficient diet. The significance of urinary excretion of these substances in nutritional and in clinical muscular dystrophy cannot, at present, be evaluated.

ZIERLER et al (41) report an investigation of several causes of creatinuria. They found that in Cushing's disease, during the puerperium, during administration of desoxycorticosterone acetate and with administration of thyroid to patients with hypothyroidism the resorption power of the renal tubules was reduced and creatinuria followed. Another method, (possibly increased synthesis and glomerular filtration) was associated with administration of methyltestosterone. A reduction in muscle mass, as in an old case of poliomyelitis, failed to give adequate bulk for proper creatine disposition with resulting increased renal excretion. Finally it was felt that anomalous absence of creatinuria in patients with myotonic dystrophy may be secondary to reduced synthesis. The authors felt that the creatin coefficients and serum concentrations were functions of both active muscle mass and glomerular filtration rate.

Eleven authors write on physiological biochemistry. Among these, CREESE (42), using normal and denervated rat diaphragm muscle, reports a study of the action of carbon dioxide-bicarbonate buffer on tension and contraction height and found that the presence of bicarbonate was necessary for normal twitch tension.

HOBBIGER (43) finds that in high concentrations physostigmine produces contraction of the frog's rectus muscle in which cholinesterase has been completely inactivated by tetraethylpyrophosphate. Anticholinesterases antagonize the blocking action of curare on acetylcholine, not of other exci-

tants like nicotine.

FATT (44) gives the results of his studies on the depolarizing action of acetylcholine on muscle. The region of greatest density of motor nerve endings in a frog sartorius was determined by finding the region of greatest depolarization produced by a solution containing physostigmine and acetylcholine. Depolarization and contraction were greatly reduced after bathing the tissue in Ringer's solution in which NaCl was replaced by glucose. The response to KCl was not abolished by lack of NaCl.

PETTKO and STRAUG (45) report an analysis of action of adenosinetriphosphate and of boiled muscle extracts on the quinine treated isolated frog heart in which they found that the active substance in muscle extracts which restores normal function of the heart is identical with adenosinetriphosphate which in the tissues is never completely broken down. A constant percentage of the total adenosinetriphosphate of skeletal muscle liver and kidney is never split by the tissue enzymes even on prolonged standing. This fraction is believed to be bound to proteins as adenosinetriphosphate.

A flavone isolated from lucerne by FERGUSON et al (46) is discussed. It was found to initiate smooth muscle movements, like other flavones. Purification has shown it to be tricin. Certain lucerne flavone preparations, however, were found to possess greater activity on smooth muscle movements than the purified isolated tricins.

JACOBI et al (47) find that malic dehydrogenase, cytochrome oxidase, succinic dehydrogenase, lactic dehydrogenase, fumarase, and adenosinetriphosphatase activities in muscle (gastrocnemius) homogenates from rabbits with incipient nutritional muscle dystrophy are the same as in homogenates from normal animals. The same is true for uricase and adenosinetriphosphatase activities of liver homogenates from normal or dystrophic rabbits.

GORDAN et al (48) report that testosterone propionate did not affect the atrophy of the anterior tibial muscle of the rat following denervation. The testosterone treated animals, however, lost less body weight following the operation than did the untreated animals. There was no difference in the length tension relationships when compared on the basis of cross sectional areas in the treated and untreated groups. It is concluded from these studies that testosterone offers little or no promise in the treatment of the atrophy of denervated skeletal muscle.

Crotonoside (isoguanosine) is shown by EWING et al (49) to be much more active than adenosine in reducing the blood pressure in rabbits and cats, in decreasing the tone of isolated intestinal strips of the rabbit, guinea pig, and hamster and in stimulating the isolated uterus of guinea pigs and hamsters. The difference in activity of these two compounds is considerably more marked with the guinea pig tissues than with those of the rabbit, cat, or hamster. Possible relationships to theories of action of adenosine are discussed.

FONTAINE et al (50) produce Volkmann's contracture by injecting tenellyl into the brachial artery of dogs. They conclude that the sympathetic chain does not participate in this reflex. The drug seems to act directly on the muscle tissue.

JARCHO et al (51) report that bis-trimethylammonium decane (C^{10}) depresses markedly the twitch tension of innervated rat muscles and causes asphyxial death unless respiration is artificially maintained. Depression occurs without change in the action potential of motor nerve or in the capacity of muscle to respond to direct stimulation. C^{10} reduces end plate potential below the amplitude necessary for initiation of a propagated electrical response in muscle fibers.

LORETI (52) reports on his study of the zonal precipitations, in parallel laminae, obtained in glass tubes, attaining the diameter of 0.4 millimeters. The reactions have taken place sheltered from light and at temperatures varying between 15 and 30 degrees centigrade. The salts placed in contact, dissolved in distilled water or in watery or formolic agar, were: silver nitrate, potassium chromate, sodium iodide, chloride, and bromide, calcium chloride and disodic phosphate, variously associated. The comparison of the images thus obtained with those offered by the organization in transversal strips of the striated muscular fiber, in the muscles both of the wings and of the legs in some insects, shows a suggestive analogy at least formally. Nevertheless, on the grounds of the investigation made by him, the author arrives at the following conclusions that no genetic or structural correlation can exist between the two orders of facts; that the topographical and spatial analogies between the zonal laminae and the transversal strips (or striae) of the muscle fiber are merely apparent; that the "rhythmic" distribution of components of various nature along the myofibrillae depends on more complex and various mechanisms than the ones applied in the determination of the salt precipitations in vitro. The definite organization of the myofibrillae, and therefore of the striated muscle fiber, must be connected with the interaction of complex factors, not only of chemical or physiochemical but functional nature, variously coordinated and combined and acting in a colloidal medium endowed with life and eminently plastic.

Two authors discuss muscle relaxants. In a survey by MUSHIN (53) attention is drawn to the essential differences in mode of action between D-tubocurarine chloride, "Flaxedil" - a synthetic tubocurarine substitute - and decamethonium iodide (C^{10} , eulissin, syncurine); the former two are antagonized by prostigmine but the latter is unaffected by this compound, being antagonized by hexamethonium bromide (C^6). The action of curare is to block voluntary muscle stimulation by acetylcholine; prostigmine causes an accumulation of acetylcholine by preventing its destruction, thereby overcoming the curare barrier. The exact site of action of hexamethonium iodide is not known. The value of curare in anesthesia is stressed and other uses of curare in tetanus, spastic diseases, and electroconvulsion therapy are mentioned.

HARRIS and DRIPPS (54) discuss the use of decamethonium bromide as a muscular relaxant in 250 surgical patients. Its dosage, physiological actions, and use with anesthetic agents are presented. Decamethonium bromide was found to be freely miscible with pentothal and to have no histamine reactions.

Skeletal System

Osteogenesis is the development of bones. Experiments on osteogenesis

in rabbits by WACHSMUTH (55) support the findings of Annersten (1940). The osteogenetic substance obtained by extraction of bone tissue is probably formed in the tissue surrounding the fracture and is not identical with the substance found in the urine. Concentrated alcoholic extracts of the various components of a long bone gave the following results: marrow extracts 71 per cent positive, cortex extracts 61 per cent, periosteum extracts 53 per cent, 14 day old callus 43 per cent, whole bone extract 92 per cent. The partial extracts caused the formation of cortical bone only. The newly formed bone is slowly absorbed.

In observations on the organic matrix of bone, ROGERS (56) states that concentration of total nitrogen in the bone tissue was found to fall with age (as anticipated by previous investigators). The amount of reducing substances also showed considerable decrease. Ground sections of bone stained by the method of Hotchkiss for demonstrating polysaccharides showed high concentrations of the material in the haversian canals and very low concentrations in the substance of the bone matrix.

In order to increase understanding of the general syndrome of pyorrhea, a study of the metabolism and structure of alveolar bone was undertaken by WEIDMANN and ROGERS (57). The rate of exchange of radioactive phosphorus P^{31} was investigated in cats. The phosphorus entered the bone salt of the trabecular alveolar bone at a rate very much less than the corresponding rate for the trabecular bone of the epiphysis and a little greater than that for the shaft of the long bone.

HANCOX (58) by the motion picture technique, finds that osteoclasts have an undulating peripheral membrane in tissue culture, and that they form fine cytoplasmic filaments. Because of this, it was felt that osteoclasts may be related more to wandering cells than to osteoblasts.

Embryonic rat femora were cultivated in a circulating medium composed of equal parts of pregnant rat serum and rat embryonic extract by MITCHELL (59). The rate of growth is very slow, when compared with growth in utero. Limb buds of 13 day old embryos differentiate into cartilage and connective tissue. The 17 day femora showed perichondral ossification and differentiated condyles and trochanters. The 18 and 19 day femora had both perichondral and enchondral ossification.

Three authors discuss anatomy of the skeletal system. MacCONAILL (60) reports a study of the movements of bones and joints. He finds that synovial fluid acts mechanically by forming a conveyant lubricant film between the fixed and the moving joint surfaces. The fatty pads assist lubrication by reducing the mechanical curvature of joint with more highly curved surfaces. The intraarticular discs and menisci increase the mechanical curvature in joints with surfaces of small curvature. Sesamoid bones exert bow-string pressure upon the bones with which they articulate.

ETTER (61) reports that roentgenograms of the disarticulated skull present a confusing labyrinth of superimposed lines and shadows. In order to separate these from one another and discover the exact details contributed by the various component bones, disarticulation of the dried skull was undertaken. Then by filming each component bone at first separately in the various standard positions and next with it in the skull it became possible

to correlate features found in the detailed analysis of the isolated bone with contiguous structures.

ASCENZI (62) discourses on the existence of bonds between ossein and inorganic bone fraction. The problem of the existence of these bonds is as yet unsettled. Caglioti has shown that the bone x-ray pattern gives evidence of the existence of a semicombined lattice formed by ossein and the inorganic fraction.

In the articles on biochemistry of the skeletal system, PAFF and SEIFTER (63) report on the effect of hyaluronidase on bone growth in vitro. Paired femora were dissected from some 60 chick embryos of six to nine days incubation and cultured for two to seven days. Those intermittently subjected to 0.6 per cent hyaluronidase-Tyrode solution grew less than the controls but bone formation was not delayed. Decreased basophilia in the treated femora is interpreted as indicating hydrolysis of chondroitin sulphuric acid by the hyaluronidase, suggesting a mechanism for the removal of hyaline cartilage during bone formation.

MANNINO (64) investigating alpha-aminovaleric acid (Norvalin) in the evolution of the fracture callus treated rabbits with experimental fracture of the radius with daily subcutaneous injections of norvalin. By comparison with a control group it appeared radiologically and histologically that healing in all its stages was accelerated by approximately 10 days.

To determine changes in endochondral ossification of the tibia accompanying acute pantothenic acid deficiency in young rats NELSON et al (65) maintained rats on a pantothenic acid-deficient diet from birth until they were moribund (three to 16 weeks). The histological changes in the tibia indicate that there is a severe disturbance in structure and that growth of the tibia is retarded. It is concluded that pantothenic acid is essential for stimulation and maintenance of normal chondrogenesis, osteogenesis, and haemopoiesis in the rat. The diet used in this study was also deficient in biotin and folic acid.

In an account of the use of tannin in arthroplasty PROVENZALE and PARIENTE (66) bathed the cancellous bone of dogs, after removal of the articular cartilage of the knee joint in a 10 per cent solution of tannin in dilute alcohol, with a resulting absence of ankylosis. In guinea pigs the same solution was injected around experimental diaphyseal fractures with the resulting absence of callus.

Sex differences in the fat/bone index are described by REYNOLDS (67) in a series of 505 children and adults. The index is defined as the relation of breadth of the fat to breadth of bone as seen in a roentgenogram of the leg. The index tends to decrease with age in males and increases with age in females. The mean index is higher in females at each age level studied. In the adult, the fat/bone index differentiates the sexes with 90 per cent accuracy. A close association between fat/bone index and body build was observed.

Miscellaneous

ALTEMEIER et al (68) report that aureomycin and chloromycetin seem to

prevent gas gangrene in guinea pigs.

HOLBROOK and PILCHER (69) report the results of their study of the effects of penicillin, peanut oil, and beeswax separately and in combination upon nerve and muscle tissue of dogs. Injections of these materials into sciatic nerve and hamstring muscles revealed occurrence of pathologic changes. Calcium penicillin in oil and wax produced marked changes while the peanut oil alone produced only mild changes. A case of degeneration of radial nerve and surrounding muscle tissue in a man following injection of penicillin in oil and wax is cited.

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CHAPTER VI

POLIOMYELITIS

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I. History

II. Research

- A. Bacteriology
- B. Serology
- C. Physiology
- D. Pathology

III. Epidemiology

- A. General
- B. Regional

IV. Clinical aspects

- A. General
- B. Etiology
- C. Diagnosis
- D. General treatment
- E. Specific treatment
- F. Treatment of associated pain
- G. Surgical treatment
- H. Other modes of treatment
- I. Prognosis

This chapter includes salient abstracts from 50 publications pertaining to the historical, experimental, epidemiological, and clinical aspects of poliomyelitis. There were approximately 132 articles considered for the review, but some foreign articles could not be obtained.

History

In an interesting article, SCOBAY (1) points out that, although it has often been stated that poliomyelitis first appeared in epidemics only 50 or 60 years ago, there is evidence that the disease has existed for centuries. Other authors have stressed this point. Prior to 1890, poliomyelitis was reported from at least 24 different countries by more than 100 different names. There is evidence that poliomyelitis was known to the ancient Egyp-

tians, and it is apparently the condition described by early Greek writers under the name of apoplexy. This term and various modifications of it are seen in the literature until the nineteenth century, applying to paralytic manifestations occurring during seasons when epidemics of polio are known to occur. The term "heat-apoplexy", which often resulted in manifestations similar to those of encephalitis and poliomyelitis, is also a name formerly applied to epidemics of disease appearing during last seasons. The criteria for the diagnosis of poliomyelitis, viz., the presence of an epidemic, fever, rigidity of the spine, pleocytosis, and paralysis, are not infrequently encountered in the cases of heat-apoplexy described by the early writers.

Research

Research in the field of bacteriology with respect to poliomyelitis includes a discussion by KESSEL and PAIT (2) of the immunologic groups of poliomyelitis viruses. The existence of different strains of polio viruses has been known for some time, but methods which permit their differentiation into neurologic types or groups are only now being perfected. Three methods are (a) challenge of convalescent, immune monkeys with heterogenous strains, (b) challenge of vaccinated, immune monkeys with heterogenous strains, and (c) performance of neutralization tests, using pools of neutralizing sera from vaccinated, immune monkeys in tests with heterogenous viruses. Data indicate that the results procured by each method are mutually confirmatory. The advantages and disadvantages of the three methods are enumerated. Recent studies by other workers on immunologic differences of strains are reviewed.

In a discussion from the BRITISH MEDICAL JOURNAL (3) on the possibility of poliomyelitis following inoculation, Professor Burnit feels that, due to inflammation following an injection, an antigen might produce involvement of small nerve terminals, a change rendering the nerve cells vulnerable. The possibility of an inoculation causing the disease to become manifest from a non-paralytic to a paralytic type is discussed.

WARD et al (4) state that the formation of neutralizing antibodies in rhesus monkeys is enhanced when the antigen spinal cord containing poliomyelitis is incorporated into a water-in-oil emulsion. The addition of a small amount of killed myco-butyricin to the water-in-oil solution further augments antibody formation. Some of the monkeys, however, develop fatal allergic encephalitis. By repeating the injections of antigen without these adjuvants, antibody titers can be produced which are equal to those found after the injection of antigen in water-in-oil emulsion, but not as high as in monkeys receiving the combination of antigen, paraffin oil, and killed myco-butyricin.

DICK (5) notes that Brunhilde poliomyelitis virus persists in rodent brains without evidence of adaptation. Adaptations of Brunhilde virus to cotton rats or hamsters is not achieved by the method of alteration of passage between these animals and rhesus monkeys. Brunhilde virus is found present in the brains of symptomless hamsters up to five days after intracerebral inoculation and up to 16 days after intracerebral inoculation of cotton rats and Swiss albino mice (no tests at longer intervals are reported). No evidence of the virus persisting after more than one cotton rat or hamster passage is reported, nor is there histological evidence of

virus proliferation. This is highly suggestive that no multiplication occurs in the brains of these animals. This persistence of virus in symptomless animals is similar to that observed by Smith in 1939 in his attempts to establish St. Louis encephalitis in rats and guinea pigs.

HURLBURT (6) furnishes data on the virus of the mouse-adapted Lansing strain of poliomyelitis, recovered after inoculation into the hemocoele of German cockroaches and houseflies. By means of this experiment, he endeavors to determine whether the virus will remain active for an appreciable period of time under these conditions. Emulsions of the bodies of the cockroaches and flies surviving for 15 and 12 days, respectively, produce typical paralysis when inoculated into mice intracerebrally.

The work of RHODES et al (7) reveals that a strain of human polio virus in a stool (specimen from child attacked with paralytic polio) can survive after addition to a sample of river water for at least 188 days and will retain its property of inducing paralysis in rhesus monkeys. Infected water is stored at approximately 44° C., and the human stool is diluted in the proportion of about 1:200. The fact that polio virus can survive for such a prolonged time under experimental conditions seems to indicate some epidemiological implications. RHODES et al (8) also report examination of sewage at two plants in the city of Toronto for 12 months with recovery of polio virus from both plants during the heights of epidemics in July, August, and September of 1949. They report isolation of the virus from sewage at one plant serving a residential area five weeks before the first reported case of polio in the district. Virus sewage has been shown to survive in the refrigerator for at least 90 days after collection.

ARMSTRONG et al (9) recovered Coxsackie virus and typical polio virus from the same stool specimen in the instances of three children in close contact. Their findings demonstrate the need for caution before attributing the etiology of any given instance of poliomyelitis-like illness to Coxsackie virus.

FABER et al (10) report studies on the entry and spread of poliomyelitis infection after exposure of the trigeminal nerve. Direct exposure to polio virus of the central end of a cut branch of the fifth cranial nerve is seen to be followed by centripetal spread of infection to the semilunar (Gasserian) ganglion with involvement of the ganglion detected both histologically and by subinoculation as early as the third day. In some instances, infection does not progress further; in others, it spreads into the central nervous system with initial involvement of the trigeminal centers in the pons and medulla as early as the fourth day and by the fifth day is further advanced but still limited to the brain stem. Once infection is established, it progresses both rostrally and caudally, at times with great rapidity, through the brain stem and reaches the cord on the sixth day or later. Incidental exposure in traumatized muscle of peripheral fibers of the seventh motor nerve leads in some instances to spread along that pathway directly into the central nervous system. Application of the experimental results to human poliomyelitis is of interest chiefly in the four hypotheses it suggests, namely, (a) that the ascent of infection from a peripheral ganglion of the head area to the central nervous system with initial encephalitis of the brain stem and subsequent descent to the spinal cord is believed to parallel the evolution of the human disease as suggested

by the character and order of development of the early symptoms and signs, (b) that the failure in some instances of infection to spread from an infected peripheral ganglion to the central nervous system may parallel inapparent (subclinical) poliomyelitis in man, (c) that viral invasion of the central nervous system, through traumatized muscle directly, also has possible analogues in human experience (to be discussed in a later paper), and (d) that the presence of well-marked, and sometimes extensive, lesions in the brain stem one or more days before symptoms emerge is also believed to parallel the human case.

Among the serological considerations of the problem of poliomyelitis is a study of serum potassium carried out in 56 patients by EARL (11). There appears to be no correlation between the severity of paralysis and serum potassium level. He records low potassium levels in ten patients with severe bulbar polio. Orally, potassium does not appear to cause any improvement in the paralysis.

KELLEY et al (12) analyze the electrophoretic pattern of the blood serum of 252 normal children and poliomyelitis patients with regard to the appearance of the beta disturbance. No correlation is found to exist between the changes observed in the beta disturbance and the severity or duration of the disease.

From the standpoint of physiology, BROWN and BRUESCH (13) present their findings on patterns of increased electrical skin resistance in 51 acute, human, poliomyelitis cases. Skin areas examined represent sites of reduced or absent sweating. The authors find areas of increased electrical skin resistance to be temporary in acute polio, returning to normal within 21 days after onset of paralysis in most cases, with a range of up to 121 days. The neuralgic lesion producing the areas of increased resistance has a cerebral location, possibly within the hypothalamus.

The pathological findings in poliomyelitis are recorded in ARCHIVES OF PEDIATRICS (14) with summaries and report of two cases with complete autopsy findings. The one case of spino-bulbar poliomyelitis and one of polio encephalomyelitis are reported.

BASKIN et al (15) report the pathologic changes in two cases of poliomyelitis of the newborn.

Epidemiology

A general survey of the clinical, epidemiologic, and laboratory aspects of a mild outbreak of poliomyelitis is made by SILVERTHRONE et al (16). The possibility that they may have been dealing with some other illness or an unusual strain of poliomyelitis virus is considered. A clinical discussion of poliomyelitis follows the summary of their study.

Many authors analyze data collected on epidemics of poliomyelitis in various regions of this and other countries. GREENBERG et al (17), in an extensive study of a poliomyelitis outbreak in New York City in 1949, report a total of 2446 cases resulting in 179 deaths. Their findings show that about 75 per cent of the cases were in children under 15 years of age, 58 per cent of the cases were in males, 45 per cent were spinal cases, and 16 per

cent were bulbar cases. A variation is noted in the distribution of cases in the five burroughs and in the different health districts. The secondary attack rate in homes where a case previously occurred is 15 times the attack rate for the city as a whole. In schools opening on schedule, the authors find no increase in the ratio of cases in school children to the total cases after the opening. Reports indicate that recent tonsillectomy appears to predispose to the development of poliomyelitis, especially of the bulbar type. There is also evidence that exercise during the onset of poliomyelitis adversely affects its course.

BLUM et al (18) and GEIGER (19) present statistics on 1948 epidemics in San Diego County, California, and San Francisco, California, respectively. WEGMAN (20) discusses the incidence and epidemic recurrence of poliomyelitis from 1932 to 1946. Higher average annual rates appear to prevail in the northern section of the country.

In discussing the poliomyelitis problem in the American hemisphere, HAMMON (21) is of the opinion that statistics on poliomyelitis as regards non-paralytic cases present difficulties and inconsistencies. He cites salient variations in time of the appearance of antibodies, age groups affected, morbidity rates, time intervals between epidemics, etc., which have been recorded in epidemics in different regions of the Americas.

LANCET (22) publishes a statistical survey of cases in the village of Digby, Lincs during the summer of 1950, and the BRITISH MEDICAL JOURNAL (23) reports the cases of polio for the week ending August 12, 1950 in county areas in England and Wales.

HARGREAVES (24) describes a severe epidemic in Cornwall during 1949 with an incidence of three cases per 1000 population. In addition, he reports on 110 individual cases. He reports one case in which the onset of paralysis is reported to have been 28 days after delivery, and the breast fed baby developed symptoms three weeks after birth with residual paralysis.

LOGAN (25) compares his preliminary observations in the 1949 epidemic with studies in 1947 for England and Wales.

In studies on the epidemiology of the 1947-48 Australian epidemic of poliomyelitis, SOUTHCOTT et al (26) find accounts of many non-paralytic cases, their diagnoses being made on epidemiological and clinical grounds. Investigators find that there were two diagnosable, non-paralytic cases to each paralytic case. Evidence from the survey favors contact as mode of transmission, and there is no reliable evidence pointing clearly to other modes of transmission, such as enteric, food, milk, animal, or insect. There is also strong evidence that a shift towards higher age incidence occurred between the first and second halves of the 1947-48 epidemic. The attack rate in older siblings is greater than in younger siblings. This fact and the lack of evidence of sufficient paralyzed to paralyzed transmissions suggest "ambulant" infectors or carriers apart from patients with diagnosable non-paralytic poliomyelitis.

Clinical Aspects

In a general discussion on some of the recent advances in poliomyelitis,

WARD (27) evaluates the attempts to purify the poliomyelitis virus. Other topics included in this article are the Coxsackie group of viruses, the finding of a protective substance against poliomyelitis in human milk and the milk of certain cows, the changing age incidence of poliomyelitis, and the relation of physical activity to the course of the disease.

Observations and treatment of 6000 cases during a four-year period lead BOWER (28) to believe that the virus localizes in the greatest quantity in the central nervous system and in the bowel wall. He feels that the virus can gain entrance via alimentary routes as well as pharyngeal. It is of interest to note that, with 6000 cases passing through Los Angeles County, no personnel contracted the disease (doctors and nurses do not wear masks). The author feels that the chief method of spread is by contact with objects which are contaminated through having been handled by carriers or patients. He feels that at present no specific measure, apart from washing hands after bowel movements, avoiding fingers in the mouth, and rest, lowers the incidence of the disease. In a subsequent article on this same study, BOWER (29) states further that the causes of spasticity and tenderness are questionable. Clinically, it is apparent that the sympathetic system is involved and lateral horn involvement may be as great as anterior horn involvement. Cervical sympathetic chains and the abdominal sympathetic plexus both have been seen to be involved. The author discusses differential diagnosis of 108 entities involved in his observations, revealing the protean manifestations of the disease. He feels that tubercular meningitis, infectious neuritis, and mumps meningitis are possibly the three illnesses most commonly confused with polio. Electroencephalographic studies reveal a higher degree of clinically undetectable encephalitis, and it occurs more frequently than previously supposed.

KELLEHER (30) discusses causal agents, clinical phases, methods of examination and assessment, useful clinical points, prognosis and differential diagnosis, and treatment.

On the etiology of poliomyelitis, HORSTMANN (31) deals with the relation of physical activity at the time of onset to the subsequent course of the disease. He states that, of 63 case studies (most patients in the five to 14 age group), analysis of activity scores for three days before onset of illness are exactly similar to those for the non-paralytic and paralytic groups, showing no difference in the degree of activity in any of the various types of cases. In his survey, the incidence of trauma proves to be low and difficult to evaluate. A total of 411 patients with poliomyelitis from three epidemics are presented: 187 from North Carolina, 208 from Los Angeles County, and 16 from New York. They are considered with reference to the amount of physical activity performed around the time of illness. The analysis reveals that physical activity performed at the time of the first phase (minor illnesses, sore throat, etc.), or prior to onset of the second phase, is not associated with an increase in the subsequent development of the severity of paralysis. However, when physical activity is performed after the major phase or major illness (pre-paralytic), it is associated with significant increase in the incidence and severity of subsequent paralysis. Correspondingly, a significantly higher percentage of non-paralytic than paralytic patients give a history of bed rest or minimal activity during the early stage of the major illness.

CURNEN et al (32) report a disease resembling non-paralytic poliomye-

litis associated with a virus pathogenic for infant mice. The observations of the clinical features in ten patients with the syndrome of aseptic meningitis or non-paralytic poliomyelitis, from whom the new virus was isolated or whose serum neutralized it, are similar to those in cases attributed to infection with polio virus. From present knowledge, it appears that strains of a virus pathogenic for infant mice are widely distributed in nature and that, in mass acute illnesses associated with this agent, it may resemble poliomyelitis, epidemic pleurodynia, or a mild, undifferentiated fever.

The diagnosis of poliomyelitis is the subject of an article by ABBOT (33). He gives a rather complete summary of poliomyelitis and states that the age incidence of the disease seems to be changing. The greatest number of cases has shifted within 15 years from the infant to four-year age group to the five to nine-year age group. It is pointed out that neither a clinical nor a laboratory diagnosis can be made for the abortive type of poliomyelitis, as this is a systemic stage of the infection without involvement of the central nervous system. Non-paralytic poliomyelitis may be diagnosed from history, symptoms, clinical signs and spinal fluid findings, even though no paresis or paralysis develops. The principal symptoms and signs are fully covered in this article, as well as the available laboratory findings. Differential diagnosis with illustrative examples are presented.

A prize essay written by VOGEL (34) includes discussions of the concept of etiology, mode of transmission, portal of entry, factors in immunity, differential diagnosis, types of treatment, control and research.

Treatment of the disease is considered from several points of view. General treatment of anterior poliomyelitis is elaborated upon by RANSOHOFF (35), in regard to the spinal, bulbar, and encephalitic types of the disease. The proper uses of curare and its indications and contraindications are given specific mention. This article also includes discussions of the classifications, symptomatology, physical examination findings, laboratory findings, and differential diagnosis.

STIMSON (36) debates certain points in the treatment of acute poliomyelitis. He discusses indications for tracheotomy, its advantages and disadvantages. He also contemplates the question of hospitalization, the question of lumbar puncture, the usage of drugs (priscoline, penicillin for infection, furmethide, atropine), oxygen, postural drainage, tank respirators, chest respirators, rocking bed, and the use of various sedatives and anti-spasmodics. He emphasizes the importance of the fact that treatment that is not indicated is contraindicated.

Specific treatment with aureomycin, according to APPLEBAUM and SAIGH (37), does not alter the course of the disease. Their conclusion is based on 38 cases treated with this drug.

STONE (38) gives a report on intraspinal administration of pyridoxine and thiamine hydrochloride and artificial fever therapy in the treatment of anterior poliomyelitis. This combined intraspinal vitamin therapy and artificial fever appears to shorten appreciably the painful phase of the disease in the more severely paralyzed, hastens restoration of normal strength in weakened muscles, and thus affects reduction in hospitalization and treatment costs. Results, so far, indicate that this is the most promising method

of treatment in polio after paralysis has set in.

In a report covering 277 patients with polio (126 non-paralytic, 59 paralytic, and 92 bulbar), FOX and HORNBERGER (39) quote a mortality rate of 47 per cent, or 44 deaths. A mortality rate of 34 per cent is seen in 29 patients with bulbar and spino-bulbar polio treated with phenosulfasole (darvisul), and, during the same period, a mortality rate of 42 per cent is recorded for 19 patients not receiving the drug. Dosage was 400 millegrams per kilogram per day. The authors' impression is that the drug offers little in the treatment of polio.

In the treatment of pain associated with poliomyelitis, REILLY and BARSANT (40) find that priscoline is less effective in reducing pain and spasm than are hot packs. Of their 35 cases, less than one-fourth are reported definitely benefited, almost one-half are not benefited, and the remainder are doubtful or cannot be evaluated.

GEISLER et al (41) also question the effectiveness of priscoline. They evaluate its use in a two-group study of children with pain, muscle tenderness, and hypertonic contracture with added paralysis as a result of poliomyelitis. They feel that priscoline is not of any particular value as an adjunct to physical therapy.

On the basis of the personal experience of one of the authors and of his contacts with other patients, GUYTON and REEDER (42) describe the pain of poliomyelitis as that commonly observed after a muscle bruise or after severe exercise, or that of a stiff neck after sleeping in a cold breeze. Experimental studies on ischemic pain in the arms of human subjects suggest that this type of pain is not the same as that of poliomyelitis. Studies on ischemia in the legs of dogs, as well as in the arms of human subjects, show that blood flow must be stopped from 90 per cent to 95 per cent of the time in order to produce pain. There is no evidence that this degree of ischemia exists in the muscles in poliomyelitis. In experiments with 25 dogs, anterior rhizotomy reveals that a type of lesion physiologically resembling the lesion of poliomyelitis invariably causes extreme sensitivity in the affected leg. It is concluded that the pain and contracture in poliomyelitis are probably due to local pathological changes in the muscle following denervation. It is postulated that the pain of poliomyelitis may be caused by the products of cellular degeneration and that the value of vasodilation in the treatment of this symptom is in the increased removal of such products. Neurogenic spasm as a cause of contracture and pain is discussed, and it is concluded that there is no evidence to support such a concept, chiefly because even totally paralyzed muscles undergo the same type of contraction as do other muscles.

Surgical treatment is discussed in three articles. Five detailed case reports are presented by HARMON (43) in which there is total paralysis of at least the anterior and middle portions of the deltoid and partial involvement of the accessory shoulder muscles. The author's experience suggests (a) that scapular fixation or relative immobility can be secured either by muscle control, contracture or axioscapular fascial transplants, (b) that there should be fair to good function in the rotator cuff muscles, especially in the supraspinatus, and (c) that effective external rotation of the humerus must be either present or obtainable. The outcome has been good,

with results superior to arthrodesis in range of motion and satisfaction to patient.

Transplantation of the external oblique muscle for abductor paralysis is a procedure recommended by THOMAS et al (44). The authors utilize the lower portion of the external oblique muscle, which is mobilized with a long strip of insertion and passed subcutaneously and reinserted through a drill hole in the greater trochanter. Patient is immobilized in a spica cast for four weeks, and then active abduction exercises are begun. Weight bearing is initiated at eight weeks. There have been 27 procedures carried out in 25 patients with all patients showing improvement in abductor power and an increased sense of security although some retain a limp. No tendency toward weakness of the abdominal wall is noted.

FLORIAN (45) reports the use of periosteal elevation, supplemented by three longitudinal splits of the tibia made with a motor saw from the upper to the lower epiphyseal plate, as a method of increasing leg lengths in two patients, ages seven and ten, with poliomyelitis. The results are an increased rate of growth, equalization of a 1.25 centimeter difference in leg length, and increase in tibial thickness.

Several other modes of treatment are suggested by various authors. SARNOFF et al (46) use electrophrenic respiration in acute bulbar poliomyelitis in management of respiratory irregularities. Respiratory center involvement contributes significantly to the respiratory arrhythmia and dyskinesia seen in that disease. In nine patients with central respiratory irregularities due to bulbar poliomyelitis, the authors report suppression in each case by electrophrenic respiration with provision of regular effective ventilation instead. The electrophrenic respirator is not a hazard in the presence of circulatory inadequacy and may actually elevate the blood pressure and cardiac output in these circumstances. The usefulness of the electrophrenic respirator cannot be considered established in bulbar poliomyelitis until additional experience has been obtained, but the foregoing data are encouraging. The apparatus should not be used unless the operator has acquired sufficient proficiency in its use. However, practice on normal volunteers is readily acquired. The electrophrenic respirator is seen to diminish considerably and strikingly the restlessness and hypertension in one patient and achieve similar results in others. The mechanisms involved are not known. It is thought that nursing care is facilitated in the treated group of patients in comparison to what is usually the case with tank-enclosed patients.

HANSSON (47) takes up the care of upper extremity paralysis in poliomyelitis. He stresses the following: (a) the principal therapy for the after-effects of poliomyelitis anywhere is to release spasm, support and strengthen weakened muscles, and prevent deformity, (b) it is especially necessary to use the proper brace in cases of paralysis of serratus magnus and deltoid muscles, (c) electrical stimulation is indicated when one muscle or a small muscle group is paralyzed, and (d) weight lifting exercises are recommended for increasing strength of muscles.

Physical medicine measures used in the Los Angeles County Hospital during the 1948 poliomyelitis epidemic in cases of respiratory patients are described by AUSTIN et al (48). They discuss the use of packing, position-

ing, and muscle re-education in a large series of cases. The care of patients and respirators is also discussed at considerable length. AUSTIN et al (49) also discuss the administration of the physical medicine department at the Los Angeles County Hospital during that epidemic with particular emphasis upon the ratio of patients to therapists, training methods for packers, department supervision, patient disposition and follow-up, and home assistance by public health nurses.

His findings on prognosis in poliomyelitis are compiled by LENHARD (50). He compares a survey of the 1944 epidemic of poliomyelitis in Maryland, including data concerning the incidence, the mortality, and age, sex, and the types of the disease, with a survey of the 1941 epidemic in Maryland. The results of the two epidemics are similar, slightly more patients with residual involvement being seen in 1944. Good recovery is recorded for approximately 80 per cent of the patients, and, apparently, treatment aids in attaining maximum recovery. Delay in recovery and persistence of weakness are observed in patients allowed to fatigue muscles by over-treatment, too much activity, or lack of necessary support. Treatment given without regard to the protection of muscles results in a greater degree of residual involvement and more deformities. The preceding represents a two-year follow-up study.

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CHAPTER VII

NEUROMUSCULAR DISORDERS EXCLUSIVE OF POLIOMYELITIS

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- I. Cerebral palsy
 - A. General
 - B. Drug treatment
 - C. Orthopedic treatment
- II. Myopathies
 - A. Congenital
 - B. Myasthenia gravis
 - C. Atrophies and dystrophies
 - D. Miscellaneous
- III. Nervous system disease of various causes
 - A. Multiple sclerosis
 - B. Paralysis agitans
 - C. Guillan-Barre syndrome
- IV. Traumatic infections and toxic lesions
 - A. General
 - B. Peripheral
 - C. Spinal cord
 - D. Brain
- V. Pain
 - A. General
 - B. Miscellaneous

There are 144 articles represented in this chapter, selected from the 164 which were considered.

Cerebral Palsy

Seven abstracts are included under general discussion of this disease.

GAUGER (1) studies cerebral palsy as to ratio of births, etiology, major forms, mental deficiency, other defects, and physical disability. Treatment should be conducted by a physician trained in the problems of the cerebral palsied. According to the author, this article forms a good compendium of the subject for the casual reader.

GIDEN (2) states that the cerebral palsied should be taught the importance of neat personal appearance, self expression, interest in the outside world, religious faith and to be accepted by the community.

A survey of cerebral palsy patients in Schenectady County by LEVIN et al (3) indicates that the incidence of this disease is 5.9 per 1000 live births, and the prevalence is 152 per 100,000 population. Financial strain is evident in all but the highest economic levels. 27 per cent of the patients, five years of age or older, have never attended school, and 34 per cent require special classes or institutional care. 62 per cent of the patients, 20 years of age or older, have never been employed, and 17 per cent are employed either irregularly or on a part-time basis. The Schenectady County survey indicates that 9.0 per cent of cerebral palsy patients require no services, 64.1 per cent need services on an ambulatory basis, 8.3 per cent require prolonged medical treatment at a hospital-school, and 18.6 per cent should be placed in institutions for custodial care.

From an etiological standpoint, GAUGER (4) presents a statistical survey of a group of institutionalized cerebral palsy patients, and finds that nearly 45 per cent are first born or born after an interval of 10 to 15 years, and he concludes from the survey that birth order may play an important part in the etiology of cerebral palsy; that intelligence and physical handicap may vary widely even in a group of mentally defective cerebral palsy patients; and that in this group, epilepsy is an important factor.

The medical considerations and classifications of cerebral palsy are presented by FAY (5). The chief recognized causes of cerebral palsy are as follows: (a) birth trauma, (b) RH factor, (c) hypoxia, (d) virus infections, (e) meningitis, (f) tumors, (g) congenital anomalies, (h) defects in circulatory or spinal fluid mechanisms, and (i) systemic factors that secondarily affect the normal functions of the brain. A classification table was presented: (a) spastic paralysis - cerebral, (b) athetosis - mid-brain, (c) tremors and rigidities - basal ganglia, (d) ataxia, (e) high spinal spastic - medulla, (f) mixed - diffuse, (g) emotional release, (h) head, neck, arm, (i) shudder type, (k) rotary type, (l) dystonic type, and (m) flail type.

Early diagnosis of cerebral palsy is discussed in general terms by AGASSIZ et al (6) with comparison of development of normal infants, and those with brain damage. They describe a number of reflexes which are of aid in diagnosis.

MALZBERG (7) analyses 544 cases of cerebral palsy with mental deficiency. 82 per cent are either imbeciles or idiots and 15 per cent were morons. The racial distribution indicates a probably excess of Hebrews. There is a probable excess of later born also.

In an article on treatment of the hopeless cerebral palsied patient HIPPS (8) defines the hopelessly paralyzed cerebral palsy patient and states

that the chronology of motor skills learned by the normal patient can be tabulated in order of importance for the development of self sustaining individual.

Drug treatment of cerebral palsy is considered. MICHAIL (9) reports the use of curare in the form of "intocostrin" in 17 children, ages two to 16 years, with spastic syndromes. The dosage is 0.5 units per kilogram for the first injection and 0.75 units per kilogram in subsequent injections, intramuscularly, once per week. In 10 cases, complete relaxation of the striated musculature was seen; in five, the effect appeared more slowly; and in two, no improvement was seen. The relaxation appeared after 20 to 30 minutes and was total after an hour; its duration, two to three days. During this period, the physiotherapist's work was facilitated.

THYGESEN and CHRISTENSEN (10) recount their experiences with curare in spastic conditions. They list the preparations of curare and data for the estimation of the effect. The authors conclude that curare therapy cannot replace the physiurgic and orthopedic treatment, but it may serve as a supplement to such treatment.

HIPPS (11) describes administration of tolserol (3-orthotoloxyl-1, 2-propanediol) to 19 cerebral palsy children in an effort to determine its value as a therapeutic agent. The author says that in 12 of the 19 patients, the mothers thought the children had improved. In 49 per cent of the patients tested, tolserol produced increased muscle relaxation, but in only 16 per cent was there any improvement in muscle control. Another 16 per cent showed a decrease in muscle control.

FRANTZ (12) reports oral tolserol to be well tolerated over a seven month period in 23 of 27 children with cerebral palsy. Children with spasticity and rigidity are not reported to respond satisfactorily in the group evaluated. On 16 athetoid children, 14 demonstrate beneficial effects. Children over 10 years of age seem to respond better than the younger subjects. The opinion of the speech instructor and physical and occupational therapists is that the drug certainly deserves a trial in the athetoid group.

PERLSTEIN and BARNETT (13) evaluate neostigmine therapy in cerebral palsy in 60 patients. Only three of the cases can be said to have shown improvement. The authors conclude that neostigmine therapy has not shown sufficient specific benefit to merit routine use in any form of cerebral palsy and that it may be wise to allot a greater portion of the general treatment to psychiatric therapy.

As regards orthopedic treatment of cerebral palsy, surgical division of the patellar retinacula to improve extension of the knee joint in cerebral spastic paralysis by EGGERS (14) is a well thought-out solution to a common problem. In flexion contractures of the knee joint due to spastic paralysis, the quadriceps tendon is stretched and prevented from fully extending the knee, because the less stretched fibrous and muscular retinacula on the medial and lateral side of the knee joint prevent full extension. Contractures are overcome by first performing various hamstring release operations, preferably with transplantation to the femoral condyles and then incising the fibrous and muscular retinacula on the medial and lateral surfaces of the joint, leaving the capsule and synovium intact. From 1937 to 1948 the author

records the treatment of 63 cases, seven hemiplegics and 56 diplegics, with satisfactory results in four hemiplegics and 47 diplegics.

HIPPS and WATERS (15) present case reports which clearly indicate the following specific benefits that can be gained from the use of braces in cerebral palsy: Securing of muscle control is accelerated; elimination of many surgical procedures; correction of some deformities; and prevention of beginning deformities.

ELLINGSEN (16) discusses the physiotherapeutic techniques in the five types of cerebral palsy considered to be treatable. While no new measures are advocated, the article forms a satisfactory compendium of existing modalities.

ZAMUDIO and LEYETTE (17) of Mexico give the incidence of cerebral palsy as being 7 per 100,000 population and outline the indications for physical and occupation therapy according to each of the five types.

Myopathies

Of the first group to be taken up are those considered to be congenital. HIRSH et al (18) report that myotonia congenita is a hereditary condition in which the patient is unable to relax his muscles quickly after a strong voluntary contraction as opposed to amyotonia congenita. Various authors report increased excitability, increased myotonia on chilling, on administration of epinephrine and prostigmine, and relief of symptoms on administration of quinine. A six year old negro boy with the classical picture of myotonia congenita is presented. He had pronounced hypertrophy of many of his skeletal muscles, and an inability to relax antagonistic muscles rapidly. Both the patient's mother and maternal grandmother suffered from the disease. Attempts at demonstrating a myotonia-inducing substance in the blood had been unsuccessful. Curarization of this patient did not influence the myotonic pattern of response.

Two cases of congenital myasthenia, occurring in a brother and sister are reported by LEWIN (19). In each case the disease process was seen clinically before birth as a delay in quickening. The one case, a male infant, had involvement of the musculature supplied by the cranial nerves, particularly that of the eyes. He responded well to neostigmine when first seen at the age of four years. He died at the age of 10 years with pneumonia when neostigmine was withheld. The second case, young sister of the previous case, showed similar, less severe involvement, and she too responded to neostigmine therapy. Quinine sensitivity tests indicated the mother did not have latent myasthenia. Two of the mother's first cousins had bilateral congenital ptosis. Congenital myasthenia as illustrated by these cases differs from myasthenia gravis by its prenatal inception and by its perfect symmetry in the pattern of muscular weakness. This disorder is also distinct from neonatal myasthenia, a severe but transitory myasthenic state occurring occasionally in children of myasthenic mothers.

The first article under myasthenia gravis is one by STORTEBECKER (20) who suggests the possibility of an infective factor as its pathogenesis. The atrophy of some muscles, the round cell infiltration, the lymphocytosis and monocytosis, and the abnormally high antistaphylocytolysis titre are cited in

strong support of the infective factor.

GROSSE-BORCKHOFF and WELTE (21) are of the opinion that the appearance of myasthenic symptoms is probably caused by insufficient acetylcholine at the motor nerve ending. These fatigue symptoms occur in muscles not used when some substance, probably with a curare-like effect, has passed into the blood. The nature of these substances is discussed. They state that the symptoms disappear quickly without prostigmine.

Myasthenia gravis, from an insurability point of view, is discussed by WEISMAN (22) where untreated myasthenia gravis may not cause death for many years, and it is usually characterized by spontaneous remissions which may last for one month or for 20 years. The therapeutic use of prostigmine had definitely lowered the mortality of the disease. Viets' mortality estimate of 10 per cent is probably as accurate as can be obtained.

THIBAUDEAU (23) gives a description of a malignant myasthenia in a four and one-half year old child with death in six months from heart failure. He states that prostigmine had little effect and that the thymus showed lymphoid inflammation.

RITTER and EPSTEIN (24) interpret treatment and autopsy findings in a case of myasthenia gravis in a nine year old girl. In addition to thymectomy, a variety of therapeutic materials, including prostigmine, adrenal cortical extract and ACTH are reported to have been tried without success. A bibliography is appended.

KATZ et al (25) give an account of clinical remission in myasthenia gravis, induced by eight daily 25 milligram doses of adactar, a long-acting ACTH preparation. It is suggested that this patient met the state of ACTH lack induced by ACTH withdrawal by producing a sustained increase in adrenal cortical function.

CLAGETT et al (26) describe the surgical technique of thymectomy for myasthenia gravis. They conclude that there is some connection between the thymus gland and myasthenia gravis since tumors of the thymus occur in 15 per cent of all cases of myasthenia gravis. The exact nature of the relationship is unknown. It is recommended that thymectomy be advised in all instances of thymic tumor if the condition warrants. (Ed: The authors are unable to show statistically that patients with myasthenia who have had thymectomy have benefitted materially from operation when compared with a group treated by medical means.)

WEILL et al (27) report that after a febrile illness a girl of nine years developed a picture of myasthenia gravis with rapid aggravation. Denervation of the right carotid sinus was performed, but six hours later the child showed agitation and rapid pulse, lowering of the arterial pressure and frothing at the mouth. Despite prostigmine and stimulants the child died after 24 hours. Autopsy revealed only slight hyperplasia of the thymus, without tumor. The cause of death is discussed -- a reflex mechanism being considered probable.

Operative attack on the thymus in myasthenia gravis is discussed by PEYSER (28) and a plea is made for surgery in cases with respiratory diffi-

culty. A ten month follow-up on a case of myasthenia with complete remission following removal of malignant thymoma is given.

A case of myasthenia gravis associated with undetected thymic reticuloendothelioma is described by DE VIDAS (29). During the two year course, patient is said to have developed eye signs with subjective vague colored scotoma, supposedly produced by alterations in the refractive index of the visual media by prostigmine.

RIDER and McDONALD (30) present one case of myasthenia gravis resistant to prostigmine therapy and associated with a malignant tumor of the thymus gland. A review of the literature citing previous instances of a thymoma in other cases of myasthenia gravis are listed. The writers feel that the possibility of a malignant thymoma should be considered in every case of myasthenia gravis.

WEISMAN (31) reports a case of myasthenia gravis in which the patient complained of weakness and fatigue. Decidedly increased weakness occurred following administration of quinidine. Response to treatment with neostigmine was prompt and dramatic and was accompanied by almost complete cessation of palpitation.

Atrophies and dystrophies: JACOBS and CARR (32) in the largest series of progressive muscular atrophy of the peroneal type thus far reported, discuss the orthopedic management and end results. They report on 80 cases, 45 treated surgically with a five year or longer follow-up on 25. References to historical data, hereditary factors, signs and symptoms are made, together with an extensive bibliography. Surgical management consists of plantar fasciotomy and/or lengthening of the tendo Achilles as indicated, then foot stabilization of the "Hoke" type, followed by section or anterior transplantation of the posterior tibial tendon or of the anterior tibial tendon as determined by existing strength. The results are encouraging.

TANSELL (33) describes two classical examples of progressive muscular atrophy of the type described by Charcot and Marie. He mentions that some authors have attributed this progressive muscular atrophy to luetic infection, but in his cases, he has eliminated this possibility from the etiological factors. The details of diagnosis are enumerated in great detail.

CRITCHLEY (34) gives the history and classification of the muscular dystrophies. There is a constant involvement of muscles of the following three classes: those muscles which develop early in the fetus; those muscles which are regressive; those muscles essentially associated with the function of fixation or the maintenance of posture.

PERKOFF and TYLER (35) investigate muscular dystrophy as to the significance of myobilin in stool pigments. The substance "myobilin," described by Meldolesi, is present in stools of normal patients, and no significance can be attached to this finding in muscular dystrophy.

BOYES et al (36) demonstrate the pedigree of hereditary progressive muscular dystrophy. The disease has been transmitted through three generations. A single dominant mode of inheritance seems to be indicated in this pedigree; however, since the only married male patient who produced sons

did not transmit the disease to them, a dominant sexlinked type of transmission (as previously reported by Bell) cannot be excluded.

MAYERHOFER (37) reports improved function in cases of progressive muscular dystrophy with the systemic administration of small to medium doses of insulin. He finds it especially advantageous in more recent cases in whom advanced muscular wasting and pseudo-hypertrophy is not yet present. He attributes the cause of this functional improvement to the increased formation, better storage, and improved consumption of glycogen in the diseased muscle itself.

MEURER (38,39) interprets the results of treatment of muscular dystrophy with resection of the carotid sinus nerves. Appreciable improvement was seen in 17 cases.

Treatment of progressive muscular dystrophy is outlined by MAYERHOFER and GRUNER (40).

SINNIGE and HARTOG (41) relate the case history and autopsy findings on a 41 year old man who had developed dystrophia myotonica at 17. The findings were as follows: total alopecia, facial and soft palate paralysis, atrophy of the sternocleidomastoid muscles and of the muscles of the hands, great difficulty in opening the fist, myotonic contractions of the hand muscles and of the tongue, absence of the Achilles tendon reflex, testicular atrophy, absence of libido, spathy. The autopsy findings are described. Reference is made to the cases of dystrophia musculorum progressiva following poliomyelitis which are described in the literature.

KEIZER (42) and COPELLO (43) each report a case of muscle dystrophy.

BOECKER (44) offers x-ray pictures of the gastrocnemius in a case of juvenile form of progressive muscular dystrophy in which the muscle fibers were penetrated by a fish bone like pattern. The etiology and pathogenesis of the diseases are discussed.

The miscellaneous articles include one by BINGHAM (45) who presents 59 cases of muscular fibrodystrophy of children. The symptoms consist of easy fatiguability and muscular cramps in the back and legs. There is poor posture, and there may be scoliosis, pes cavus and contracted toes. There is usually a history suggestive of a mild attack of poliomyelitis. There is no true muscular weakness, but rather firm contracted muscles. Neurological examination is negative except for depressed deep tendon reflexes. Treatment is usually successful and is conservative consisting of hot packs, stretching and manipulation. The author suggests that this disorder probably represents cases of mild untreated or unrecognized poliomyelitis. (Ed: Confirmation of this entity is lacking as are the pathogenetic implications.)

Scapulo-humeral myopathy is discussed by EUZIERE et al (46).

HYLAND (47) discusses the syndrome of periodic paralysis which includes intermittent attacks of flaccid paralysis of the trunk and extremities, usually coming on during sleep, with diminution or absence of tendon reflexes and impairment of electrical excitability of muscle and nerves. Consciousness is retained throughout. In a large percentage of cases, there is hered-

itary and familial incidence of the condition, but at least 20 per cent of the cases occur sporadically. Attacks of paralysis in susceptible individuals usually come on when the level of potassium in the serum is 12 milligrams per cent or less. Potassium levels of this degree do not affect normal individuals. Administration of adequate amounts of potassium salts brings about rapid recovery from paralysis in susceptible individuals. The etiology of the condition is thought to be innate metabolic or neurogenic defect. The observations on a sporadic case are reported.

WISWELL et al (48) describe the Sturge-Weber syndrome as consisting of a combination of a facial vascular nevus, intracerebral calcification, convulsions, ocular abnormalities, and mental retardation. A case is reported.

Authors MILLER and MILLER (49) discuss the group of conditions termed post-traumatic reflex dystrophies. The syndrome is common, follows injury and presents pain, vasomotor changes and altered motor function. The syndrome usually responds to early treatment of sympathetic blocking drugs or local sympathetic blocks before fibrotic and trophic changes take place. (Ed: Severe irreversible dystrophies may require preganglionic sympathectomy in the cervical area. Unfortunately no proven means of case differentiation exists as yet.)

A syndrome complex comprising numerous visceral, somatic and emotional disturbances is described by GAYRAL (50). In general, a physical basis for a class of vague, bizarre and often baffling symptoms is given. The primary patterns consist of attacks of facial, cranial and cervical pain, pseudovertigo, laryngeal and pharyngeal paresthesias and spasm, anxiety, facial vasomotor instability, neck tenderness and spasm. There is general psychic instability in these patients. It is felt that the cervical sympathetic system with its intracranial anastomoses produces this complexity, often secondary to cervical trauma or arthritis. Less frequent are attacks of general visceral dysfunction; bizarre somatic sensations; or patterns of thought fogging, chilled perception, asthenia, retinal hypotension and mydriasis. The use of paravertebral cervical blocks, treatment of arthritis, demineralization, and subluxation in the care of these cases is discussed.

GUILD (51) studies the effects of decamethonium iodide in muscular hypertonus in seven cases. In two cases, improvement in performance, although significant was not dramatic, and beneficial results were transitory. Unpleasant side effects largely offset the advantage of better performance.

SCHACTER (52) summarizes the findings in general paresis of children, including occurrence of tabes and convulsive crises. He concludes that modern antibiotics may modify the usual poor prognosis.

Amyotrophic lateral sclerosis and its differential diagnosis is described by FRIEDMAN and FREEMAN (53). In their article they point out that it is characterized by upper and lower motor neuron pathology. It occurs most often in middle life and is progressive in the majority of cases. This paper presents a study of 111 cases. An extensive review of the literature is presented. On examination, uniform wasting of the hand muscles, widespread fibrillations, and increased deep reflexes in all extremities are prominent features of this disorder. The average length of the disease is

given as 25 months and it uniformly culminates in death. The differential diagnosis is a problem of distinguishing conditions which involve the cord and the bulb and have the clinical features of an amyotrophy, spasticity, bulbar impairment or certain combinations of these. The treatment of the disease has, so far, consisted of vitamin E (tocopherol), and more recently, cytochrome C.

ALAJOUANINE et al (54) detail a case history in a 50 year old male with amyotrophy initially in the upper limbs and neck and extending to the lower limbs. Anatomical examination showed the lesion to be exclusively spinal and degenerative in the ventral columns only.

The authors, LEHOCZKY and ESZENYI-HALASY (55), state that the exact differences between chronic anterior poliomyelitis and Aran-Duchenne disease are difficult to define. On the basis of clinical study they propose a more satisfactory neurological term as "Progressive Amyotrophical Lateral Sclerosis of the Chronic Poliomyelitis Type." They justify this on the manifestation of degeneration of the nerve cells of the spinal cord without histologic evidence of chronic or subacute inflammation.

Nervous System Disease of Various Causes

Multiple sclerosis: FELBER (56) considers geographic factors in the spread of multiple sclerosis. This disease is appreciably more common in Northern than in Southern Switzerland. Similar variations are observed in Germany, except that the disease is more common in the Western area where the population is of teutonic descent. In Europe, as a whole, the disease is more common in the North than in the Mediterranean area. The incidence is very high in Great Britain and Ireland, and statistics show that the incidence is higher in Northern Europe (especially Scandanavia, Finland and England) than in the United States.

LIMBURG (57) makes a statistical survey of multiple sclerosis as to geographic distribution, mortality, seasonal variation, sex, race, age at onset, and duration of illness. There does not appear to be any selective association between multiple sclerosis and sex, race, occupation or population density. Incidence does vary with the mean annual temperature. The colder the climate, the higher the death rate. The duration appears to be much longer than generally supposed, e.g. in the United States the median duration for a fatal case is about 27 years.

A general discussion of multiple sclerosis is given by SCHUMACHER (58). This paper presents a lengthy bibliography to support detailed discussion. The effectiveness of drug therapy in the disease is discussed and it is the author's opinion that at the present time there are no drugs which effectively control the disease.

SCIARRA and CARTER (59) report that the duration of life for 20 to 30 years is not unusual but that survival for longer than 30 years is rare. Three cases of multiple sclerosis are presented in which the patients survived 30 years, 31 years, and 64 years, respectively, after onset of illness.

MACKAY (60) makes a comprehensive study of the literature and finds that the instances of familial multiple sclerosis to date number 70, with an

aggregate of 177 persons. To these, he added five instances, including 11 persons. The author offers the following theories as consistent with the present information: (a) there is a familial, constitutional or vulnerability, to multiple sclerosis, and (b) there is a second, nonfamilial, possibly exogenous cause which is competent to evoke the disease, especially when the first, or constitutional, factor is already present. An extensive bibliography is appended to this article.

ABRAHAMSON (61) discusses 42 cases of disseminated sclerosis. He discusses in detail the possible pathogenesis and postulated the possibility of a cyclic immunity-sensitivity response to the tubercle toxin as being a possible explanation for the remissions and exacerbations seen in this disease.

ADAMS et al (62) describe the symptoms and signs of 389 cases of disseminated sclerosis. Weakness in one or more limbs was the first symptom in more than half the cases examined, while the visual upset was the earliest manifestation in an additional 26 per cent of the patients. The onset of the disease is found generally to occur in the age group 20 to 45 years, and, when disseminated sclerosis is suspected in patients outside these limits, other etiological factors should be carefully considered. Stress is laid on the need of recognition of the disease before permanent damage has been inflicted on the central nervous system. Whatever advances in treatment the future may hold, the degree of recovery will depend upon the stage at which a diagnosis is first established. The author appends a bibliography.

In a severe case of multiple sclerosis PRICK and CALON (63) report an experimental psychological test to gain insight into the processes of deterioration of personality. The IQ decreased from 94 to 34. Qualitative analysis shows that mechanical memory is most heavily damaged.

A case of multiple sclerosis is reported by SAHS et al (64). It is that of a 53 year old male who expired suddenly after a brief cardiorespiratory attack.

In an article on pregnancy and multiple sclerosis, MARTELLI (65) presents statistics from 100 cases of multiple sclerosis followed since 1943 to date. Of these, 40 are men and 60 are women. Of the latter, 22 have had no pregnancy. In four women, exacerbation of the disease is seen in pregnancy with the first manifestations in the first trimester and the disease complete (or full-blown) towards the end of pregnancy. In two cases, in the active stages of the disease, spontaneous abortion is reported in the second and third months. In six cases, the disease is said to have developed after pregnancy. The author mentions the necessity of having to advise those who are afflicted with the disease and also the family the risk of pregnancy.

Research and statistics on multiple sclerosis includes a study of the crystalline albumin, gamma globulin and total protein in the cerebrospinal fluid of 100 cases of multiple sclerosis and in other diseases by KABAT et al (66). The cerebrospinal fluid albumin and gamma globulin have been studied in 100 cases of multiple sclerosis. 85 per cent are found to show an increase in gamma globulin. Values for the cerebrospinal fluid albumin are generally normal. The increase in gamma globulin is not specific for multiple sclerosis, since similar findings are obtained in neurosyphilis and in certain other diseases. A bibliography is appended.

A group of 23 cases with a diagnosis of multiple sclerosis is studied by HESS (67) with emphasis on gastric functions. In all 23 cases, hyperacidity and hypermotility of the stomach is demonstrated. Three case histories are presented of patients having multiple sclerosis with marked gastric disorders. The pathogenesis of the hyperacidity and the hypermotility of the stomach is discussed in its relation to the lesions in the region of the hypothalamus.

Biometric-statistical data on the characteristics of arterial tension in multiple sclerosis are listed by ROGER and SCHACTER (68).

TIMME (69) discusses the concepts of functions of the spinal cord since the third century. He gives the symptomatology of multiple sclerosis as determined by the Commission of the Research Association in Nervous and Mental Disease in 1921. He ponders the pertinent question: Is the pathological process of multiple sclerosis of inflammatory or degenerative nature?

Under paralysis agitans EKBAUM (70) states that it is generally held that the reflexes in Parkinson's syndrome are fairly often brisk and variable but not abnormally exaggerated. A variation in reflex response is intermittently associated with trauma, and it concluded that the intensity of the reflex responses depends on the phase of the trauma when the stimulus is applied.

PALMER and GALLAGHER (71) analyze 16 cases of Parkinsonism treated with phenothiazine hydrochloride. It is believed to be capable of affecting beneficially any symptom or complex of symptoms from which the Parkinsonian patient is suffering, notably his mentality. The findings in the 16 patients are as follows: Complete alleviation - one; good result - ten; improved - 4; no change - one. The dosage used is four to ten tablets (50 milligrams) per day. The general toxic events of the drug are listed as follows: (a) drowsiness and lassitude with or without vertigo appearing half an hour after dosage, lasting to two hours and being most apparent in early treatment; (b) dryness of the mouth, transient diplopia, vasomotor reactions which are rarely found and disappear spontaneously. They feel it may be confidently recommended as a valuable remedy in a treatment of this condition.

Classical treatment, chiefly with Belladonna derivatives, is described by PECKER (72). The modern pharmacopoeia according to him includes synthetic anticholinergic and adrenergic compounds. A list of drugs is given. Synthetic curarizing drugs are being tried. Radiotherapy has been found efficacious in 60 per cent of the postencephalitic cases. Certain mental disturbances (agitation with perversity) may be indications for topectomy. Articular stiffness response to hot baths and massage with active and passive mobilization, and the cooperation of the patient and relatives, etc remain essential factors for success.

YOSS (73) reports 18 cases of Parkinson's disease treated with Benadryl (200 milligrams/24 hours). Objective improvement is cited in two cases. Benadryl may be of value in cases which do not respond to the usual drug therapy.

In six cases of Parkinsonism treated with Diparcol, PALMER and FLACK (74) report that two had significant responses, but one of them died from pneumonia. It appears that some cases of this disease will be benefitted,

but there is danger of reaction, i.e. conjunctivitis, giddiness, and somnolence, depression of cough reflex. (Ed: The results are inconclusive.)

The effectiveness of modern drugs in the treatment of Parkinsonism and similar diseases is debated by UBERALL and JORDAN (75). They describe a series of cases treated with sympathetic antispasmodics. Their series comprised 52 cases. They report favorable response in from one-third to one-half of the total number. The percentage of improvements noted is not felt by the authors to be higher than that obtained from the previously used solanaceous plants.

REMOUCHAMPS and VERBEKE (76) recount personal experience with artane in the treatment of Parkinsonism. They find it superior as an antispasmodic to atropine and other previously employed remedies, confirming the observation of American authors.

MAROGER (77) discusses the therapy of Parkinsonism in Bulgaria. He stresses the need for Vitamin C, a vegetarian diet, elimination of nicotine, alcohol, and caffeine. His rehabilitation program includes medication, muscle training, correction of deformities, occupational therapy and psychotherapy.

Two cases of Guillain-Barre syndrome, polyradiculitis, in infants, are reported by GLANDER (78). The first case occurred following pyoderma and the second started one week after a smallpox vaccination. Both cases recovered completely. The pathogenesis of a possible neuroallergic reaction and the differential diagnosis are discussed.

KLOVSTAD (79) reports a case of mononucleosis in a six year old boy with acute polyradiculitis of Guillain-Barre as well as otitis, lymph node enlargement, cardiac symptoms and ischiopubic osteochondritis. The author points out the possibility that the entire condition may be due to hypothetical virus of infectious mononucleosis.

CACCIAFUOTI (80) discusses the role of vasospasm in the production of CNS lesions in polio and describes a method of vaso dilation with oral digitalis and intramuscular acetyl choline. He states that many patients have shown significant regression of paralysis from this therapy during the acute stage of the disease.

Traumatic Infections and Toxic Lesions

Four articles are included under general. In the first, HAMMES (81) discusses trauma to the nervous system. He states that the history of the development of our knowledge of this subject parallels very closely the history of the war. During and following each conflict, the mass of clinical material, concentrated into centers in a way that never can be done in peace time accounts for the more rapid evolution of knowledge. He lists three outstanding contributions of the second World War to the subject of nervous system trauma. The first is factual knowledge in neurophysiology and new antibiotic agents which made possible new surgical techniques. The second is a realization that our responsibility to the patient continues through rehabilitation. The third contribution is the development in large centers of coordinated teamwork.

On technique of peripheral nerve surgery SPURLING (82) states that frequently nerve lesions are overlooked, even by physicians who are highly trained in the management of trauma. The technique of evaluating the integrity of the main nerve trunks of the upper and lower extremities by studying the movements of the thumb and great toe is described. It is recommended that all operations upon peripheral nerves be at least started under local anesthesia since much valuable information can be obtained by electrical stimulation of the exposed nerve trunks at operation. The contraindications to primary nerve repair in an injured extremity are outlined. The author favors delay of the nerve suture for 15 to 20 days after severance of the nerve, at which time the epineurium first attains the tensile strength which facilitates nerve suture. The alteration which occurs in the distal nerve segment following nerve severance is described. Analysis of data from 8000 cases of nerve suture listed in the Army's Peripheral Nerve Register indicates that in 85 per cent of cases there is unmistakable evidence of regeneration. The author observes that in nerves which supply muscles concerned with gross movement, functional recovery is more perfect than in nerves supplying muscles concerned with non-precision movement.

MERLE D'AUBIGNE (83) compiles the results in a series of 82 patients treated for residual paralysis of the upper limb. He discusses the general rules to be borne in mind in choosing between arthrodesis and muscle transplantation.

HENDRY (84) believes that it is impossible to classify the flail upper limb because of the variation of the paralyses in location and degree, and deformity. Two factors must be considered in every case: the physical conditions present in the limbs; and the general attributes of the patient. He discusses various surgical procedures for the flail limb and feels that retention is preferable to amputation.

Peripheral nerve paralysis occurring postoperatively in five cases is reported by EWING (85). Although upper arm paralysis as a sequel to surgery offers an excellent prognosis, it is distressing to both patient and surgeon, and it is preventable. The cause is thought to be stretching of the plexus over the humeral head when the extended extremity is abducted to 90° to facilitate venoclysis, etc. It is aggravated by pressure of the shoulder rest if the patient is tilted into the Trendelenberg position and more so if curare is administered, due to loss of tone in the trapezius. He stresses the importance of prevention.

KILOH (86) hypothesizes that brachial plexus injury complicating surgery is probably due to traction-compression injury, secondary to abduction of the extremity, in combination with the Trendelenberg position and the use of muscle relaxant agents. Prophylaxis is assured by maintaining the arms adducted and the elbows flexed.

PALMAR (87) describes a dynamic splint for the wrist and fingers for radial nerve palsy. The splint is constructed of plexiglas. Rubber bands are incorporated into the splint to give the flexors a certain amount of resistance for normal action.

SOINITZKY (88) states that the most common etiological factors in radial nerve injuries are: pressure, fractures, dislocations, wounds, tumors,

and peripheral neuritis. A rather complete discussion of functions and findings is given.

HUDSON et al (89) report 20 cases of unilateral sciatic paralysis in the newborn, sometimes accompanied by cutaneous gangrene. Accidental injection of cycliton into an artery instead of a vein in the umbilical cords is suggested as a possible cause of the lesions. Experimental proof is as yet lacking, but the evidence in favor of this theory is as follows: (a) the cases are reported only in the hospitals in the city of Liverpool in which cycliton was in use, (b) the only common factors were asphyxia at birth and the injection of cycliton into a cord vessel, (c) the lesions are consistent with the results of ischemia due to disturbance of blood flow in the internal iliac artery, and they are comparable to the lesions produced by intra-arterial injection of thiopentone, and (d) no further lesions have occurred since the cycliton has ceased. (Cycliton is not now sold in England, although it is used extensively on the continent and in other points of the world.)

CHAVANY and HAGENMULLER (90) present a case of sciatic paralysis from a bullet wound in the popliteal fossa 23 years before. It began with an attack of neuritis, involuntary painful, torn muscular contractions, local tenderness and progressive muscular calf hypertrophy. He discusses the possible pathogenesis.

SOHIER (91) presents a case of auto grafting of the sciatic nerve following a war wound, with improvement of the associated syndrome of causalgic pain.

MERLE (92) discusses two clinical findings in an attempt to distinguish L5 from S1 nerve root involvement. A "list" was found more commonly with the former and also sciatic paralysis was more frequent with L5 involvement. Involvement of the external popliteal nerve alone invariably indicated fifth root involvement.

DURBIN (93) summarizes the typical history and findings in cases of low back pain associated with sciatica. He stresses the conservative element of therapy even when a ruptured intervertebral disc is suspected and mentions the surgical indications and feels that a combined laminectomy and spinal fusion is the procedure of choice.

TALBOT (94) states that the Taupet and Lambrinudi operations give the most satisfactory functional results in paralysis of the external popliteal branch of the sciatic nerve.

SCHWENSEN (95) describes a case in which he attributed a transient peroneal palsy to penicillin therapy of a lung abscess. A clinical report is given of one patient with multiple cranial and peripheral tibial nerve with a satisfactory functional result following secondary suture, excision of the neuroma, and flexion of the knee. Complete function recovery in approximately 20 months is reported.

DENISART (96) contributes a case report of section of the anterior tibial nerve with a satisfactory functional result following secondary suture, excision of the neuroma, flexion of the knee. Complete function recovery in approximately 20 months is reported.

Under articles pertaining to spinal cord, BAKER (97) advocates measures to educate the public as to means of preventing injury of the spinal cord. A brief summary of the treatment of injuries of the cervical thoracic and lumbar regions by skull traction, laminectomy, spinal fusion, and braces is given.

LEVIN (98) relates that 3163 breach presentations developed lower motor neuron palsy of both legs following a difficult labor and delivery. He states that spinal tap showed a complete block and a permanent reaction of degeneration appeared in the legs.

Muscle tonus following injury of the spinal cord is described by BECKER (99). He states that the restoration of muscle tonus follows different patterns after complete transection of the spinal cord, that after transection the pattern is characterized by summation of synergic reflexes, while after pyramidal lesions it is of the spastic type. The author calls the transection syndrome "kinetic pyramidal" while he considers the pyramidal syndrome as being "static pyramidal." Early occurrence of the kinetic type is usually followed by a poor restitution of nerve function. The author feels that the kinetic syndrome is influenced greatly by the vegetative nervous system, as shown by the influence of nicotinic acid ephedrine, anxiety, rage, and its absence during sleep. He interprets the syndrome as being an adaptation syndrome.

KUNG (100) considers the present surgical treatment of spinal cord injuries unsatisfactory in that insufficient cord is exposed at laminectomy. He considers early intervention imperative to reverse the posttraumatic changes in the spinal cord and states that these changes are mainly due to vascular occlusion and therefore reversible.

COLLING and ROSSITER (101) state that cerebrospinal fluid contains cholinesterase and pseudocholinesterase. Occasionally, there is a significant rise in the true cholinesterase with syphilis, which is not correlated with either the cerebrospinal fluid, Wasserman or reaction of protein. There is an increase of the pseudocholinesterase in the cerebrospinal fluid with meningitis, and occasionally with poliomyelitis, which is correlated to a lesser degree with the protein. The authors postulate that the true cholinesterase might be derived from the brain or spinal cord and the pseudocholinesterase from the plasma. In any case, the determination of the true and pseudocholinesterase activity of the cerebrospinal fluid is of little diagnostic significance.

The concept of myelopathy, writes LEHOCZKY (102) applies to a disease of the spinal cord in which the typical histological features of inflammation are entirely absent, and the disease is considered to be due to infective, vascular, or mechanical factors. Thus, myelopathy is a degenerative affection of the cord. The mechanical form of myelopathy is not dealt with in his article. The author has observed 160 cases of myelopathy among 7445 cases (2.13 per cent) in eight years. The following differential diagnostic points are given: (a) an acute onset is common, (b) Crouzon's sign (Babinski plus Oppenheim) is not pathognomonic for myelopathy but merely shows the presence of lesions of the dorsal and lateral columns, (c) the cerebrospinal fluid and blood are usually normal, (d) the greatest difficulty is the clinical distinction of myelopathy from multiple sclerosis. The et-

iological factors include syphilis, chronic alcoholism, secondary anemia, influenza, furunculosis, inanition, diarrhea with colitis, chronic pyemia, immunization against typhoid fever, encephalitis, and nicotine poisoning. For treatment, adenosine triphosphate, vitamin B₁, and nicotinic acid, alone or in combination, are recommended.

BASTAGLI (103) tells of two cases of acute transient myelitis involving the posterior tracts and anterior horn areas respectively. Cerebrospinal fluid findings were normal and there were few sequelae.

An account is given by UNGLEY (104) of attempts to determine the nature of the agent in liver effective in subacute combined degeneration. Eight patients with subacute combined degeneration were studied by a quantitative method with vitamin B₁₂. Two were slightly, four moderately, and two severely affected. The duration of the difficulty in walking ranged from two months to 11 years. Four of the eight cases exceeded the expected rate of improvement, two attained it, and two fell just short of it. Vitamin B₁₂ is, therefore, as effective as liver extract not only in pernicious anemia but in subacute combined degeneration. The existence of a separate neuropoietic factor need no longer be postulated. Except for patients who have become sensitized to some impurity in the liver fractions, the pure substance has no advantage over the commercial liver extracts.

STECKLEMACHER (105) records the death of a woman suffering from Simmond's cachexia with spastic paraparesis and hyperalgesic symptoms of both legs. All signs of an adrenal crisis with delirium, excitement, and syncope are cited and autopsy revealed an inflammatory process of the pituitary gland, while the adrenals showed a perfectly normal structure. The spinal cord showed severe changes even to the naked eye, consisting in heterotopia of the dorsal portion on cross sections. Microscopically, scattered patches of degenerative destruction in various tracts were seen, reaching from the lumbar up to the cervical portion, without any inflammatory reaction and with intact blood vessels. The relation between the pituitary and degeneration of the cord is discussed.

BINDE (106) reports the treatment of postdiphtheritic paralysis with intrathecal injection of 0.5 milliliters of formal toxoid. Serious reactions in the form of meningitic signs appeared, but there was a remission of the paralysis with recovery from the secondary meningitis.

KISSEL and ARNOULD (107) report a case of syringomyelia in which the trophic polyarthropathy preceded the disturbance of the thermal sensation by 22 years. A localization of the lesion in the medullary synaptic area was considered possible.

BAZZI (108) presents a series of 34 cases of syringomyelia in 6000 neurological cases. The author comments that the cervical form was encountered in approximately 68 per cent of the cases, the dorsal form in 9 per cent, the lower form in 23 per cent. According to his findings, the lower form cannot be classified "exceptional" as some of the French authors have reported. The author did not encounter in his cases the findings frequently described in syringomyelia (hyperdactylia, syndactylia).

PALEY and WHITE (109) discuss diagnosis and specific therapy of influ-

enzal meningitis. Severe cases have less than 15 milligrams per cent cerebrospinal fluid sugar and are treated with combined streptomycin and sulfadiazine. Streptomycin should be given intrathecally as well as parenterally and in large doses.

HAZELRIGG and HAVEN (110) evaluate the Queckenstedt test. Cerebrospinal fluid proteins and pantopaque myelography are used in cases of spinal cord tumors whose diagnoses are uncertain. Four cases are cited in which intra or extra dural tumors were initially confused with degenerative cord conditions or functional states; diagnoses of surgical lesions were made by abnormal manometric response, elevated proteins and filling defects seen at myelography. The author states that all cases were successfully operated upon.

THOMPSON and RICE (111) report four cases of secondary amyloidosis in spinal cord injuries found at autopsy and discuss the clinical significance of this process. Spinal cord injury is accompanied by the following triad of inflammatory processes: decubitus ulcers, chronic osteomyelitis, and urinary infections along with a profound disturbance of metabolism. Amyloid degeneration is a distinct possibility but is not common. Clinical diagnosis is difficult. The elimination of infection can be a factor in the prevention of amyloidosis. The use of whole liver may help in therapy.

A clinical syndrome of nutritional origin, well-known in Singapore and consisting of lesions of the skin, mucous membranes, and nervous system is described in a case presented by DANARAJ (112). The literature is reviewed. Some of the neurological findings recorded are: burning feet, muscular weakness, ataxia, paresthesia, and loss of visual and auditory acuity none of which fit into the clinical picture of beri-beri or subacute combined degeneration with only a superficial resemblance to tabes dorsalis. The author reports that the patient seen in the Singapore General Hospital responded rapidly to a liberal diet supplemented by milk and eggs and a course of nicotinic acid and riboflavin.

Under complications SOULE and STIFF (113) describe changes in bones and soft tissue. In a series of 63 patients with spinal cord or caudal lesions, soft tissue calcifications were noted in 24. These lesions occurred about the hips and knees which is a bad sign and indicated poor prognosis. Only three of the 24 cases showed any clinical improvement. No criteria could be established at the time of writing as to which type of patients would develop ossifications. The pathomechanics of this phenomena is unknown.

MEIROWSKY and SCHEIBERT (114) report observations made on three patients with traumatic myelopathy and a segmentally innervated bladder. Bilateral sacral neurotomy of S3, S4 and S5 was performed. The patients maintained a relaxed automatic bladder, became able to have sexual intercourse, and there was some improvement in rectal incontinence and sensation.

Paraplegia is dealt with by DANE (115). He reports that of ten paraplegics (apparently of World War I) who came under his care, eight died within the first three years. The remaining two, despite section of the thoracic cord, remained in good general health after 32 and 33 years respectively. The author believes that modern treatment will increase the percentage and length of survival of paraplegics.

In the treatment of spinal paraplegia GUTTMAN (116) believes in physiotherapy and gives a detailed discussion of his beliefs. The latter half of the article is utilized in the discussion of the readjustment of normal parts by compensatory training, employing muscle exercises, braces and supports.

In consideration of the brain, an article on neuropathy is presented by IRONSIDE (117). One year duration of partial third nerve and complete sixth nerve palsy on left side, followed by sudden development of left foot drop is reported.

THOMAS et al (118) state that it has not been disproved that pallidum type rigidity cannot develop without involvement of the pyramidal tract. The author continues that it is difficult to establish in a great number of pathological cases whether there is a pyramidal contracture or pallidal rigidity. He contends that by studying the symptoms more and more thoroughly, there will be opportunity to determine the part played by the cerebellum, Goll's column and other centers that have been suggested as causes for Strumpell's disease (Polioencephalomyelitis).

BICKERSTAFF (119) presents 18 cases of familial spastic paraparesis. He discusses the signs and symptoms which give evidence of overlap with amyotrophic lateral sclerosis and cerebral diplegia. The possible genetic relationships between the ataxias, myopathies, hereditary spastic paraparesis, and other congenital anomalies are mentioned.

GARLAND and ASTLEY (120) describe a family showing a syndrome of spastic paraparesis with the unusual features of amyotrophy and marked pes cavus. He discusses this disease and notes the invariable excellent prognosis.

Articles on hemiparesis include one by SCHWARTZMAN (121) who reports a case of transient hemiparesis associated with febrile convulsions. He says that accompanying or subsequent to convulsions of febrile origin, almost anything can be encountered from irritability to coma to paralysis. The most likely explanation was thought to be due to areas of focal edema and hyperemia of the brain which accompanied the convolution.

BARUK and YOUCHEVETZKI (122) cite a case of hemiparesis in a child following tonsillectomy.

ZWEIGHAFT (123) reports a case of hemiparesis following tonsillectomy. The literature is reviewed, the role of the carotid sinus noted, and the possibility of causing brain damage by elevating and lowering the blood pressure is suggested. The use of oxygen rather than air to bring ether to the patient is advocated. Anesthesia for tonsillectomy should not be relegated to occasional anesthetists.

CHUSID et al (124) report two cases of hemiparesis following 35 per cent diodrast cerebral angiography with treatment by etomoxin chloride and subsequent recovery.

MAU (125) feels that, in certain cases of spastic pes cavus deformity, the Stoeffel operation does not correct fully or maintain correction of this deformity. He therefore advocates transplantation of the gastrocnemius

origin to the proximal tibia (Silverskjold's operation) in conjunction with the Stoeffel procedure, before considering achillotomy. He discusses the indications for this operation together with the operative technique and postoperative management, and he lists the results of eight cases so treated.

COVALT et al (126) utilize known facts of muscle physiology in the rehabilitation of spastic palsy of the upper extremity. These include the unusual power of elbow extension when the face is turned to the affected limb, and the fact that deltoid power is at maximum when the arm is at shoulder level. Their occupational therapy tasks are begun with the arm supported and then this support is gradually withdrawn. Principles of progressive resistance exercises are shown.

According to NEWMAN and COHEN (127) the outlook on hemiplegia is not gloomy. The management of the stages of hemiplegia is outlined. Methods of evaluation are described, including the consideration of neurologic, psychiatric, medical, social, and vocational aspects. The authors think the chronic, semi-disabled hemiplegic patient can be restored to a semblance of normality.

BARUK and MUNAGED (128) report four observations in which mild mental derangements were associated with Pagets Disease of bone.

Pain

Under general discussion of pain is included an article by HAWKFIELD and KEEDY (129). They report that constant pain produces slowly progressive personality degeneration which often leads to barbiturate habituation and narcotic addiction. Neurosurgical procedures designed to alleviate the suffering of patients with intractable pain may be divided into two groups: (a) those that interrupt the nerve pathway for pain and (b) those that interrupt nerve pathways that modify the patient's reaction pattern to pain. The first group has been classified under three headings: (a) interruption of nerves distal to their ganglia, (b) interruption of the sensory roots of nerves, and (c) section of the pain tracts in the spinal cord or brain. There are few indications for interruption of nerves distal to their ganglia because of loss of motor as well as sensory function. It may be indicated in cases with amputation stump neuromas, recurrent scarring about a nerve, or gangrenous extremities awaiting amputation. The interruption of sensory roots of spinal nerves, the posterior rhizotomy, produces loss of all modalities over the dermatome of that particular nerve root, but it does not affect motor power. It is ideally suited for localized pain in the trunk, less suitable for upper extremities, and rarely indicated in lower extremity pain. Spinothalamic tractotomy produces loss of sensation for pain and temperature on the opposite side of the body below the level of section. It is not the procedure of choice for pain above the nipple line. Bilateral pre-frontal lobotomy is advocated for the patient with diffuse pain or for the patient whose pain is likely to spread.

PAILLAS et al (130) discuss prefrontal leukotomy and topectomy in the treatment of intractable pain.

Many authors discuss sympathectomy and an article entitled "Surgery of the Sympathetic Nervous System" by MacCARTY (131) presents views as to

the explanation for the existence of so-called sudomotor "escape" areas on the body surface following thoracolumbar sympathectomy. The "escape" areas are irregularly-shaped areas of increased sweating usually found on the lower abdomen and anterior thighs persisting for several weeks after operation. These correspond to the dermatome segments of T12 to L3. It is suggested that intermediate ganglia together with their associated preganglionic connections and postganglionic fibers afford the anatomical explanation for the retention of sweating in the "escape" belt.

EVANS (132) gives his views on the selection of patients for sympathectomy. The more vasospasm that can be indicated as the cause of symptoms of the "picture," the better is the response to sympathectomy. The author feels that operation in upper extremity Raynaud's disease is not good, but he states that sympathectomy in lower extremity Raynaud's is excellent. Scleroderma of face and neck is greatly benefitted. Patients under 55 years of age with Buerger's or arteriosclerotic peripheral vascular disease should have a prophylactic sympathectomy. The author advises sympathetic block as an aid in prognostication. He also sets down the criteria for case selection for hypertension.

MANZANILLA (133) writes on sympathectomy of the upper extremities.

ECHLIN (134) gives a very interesting case report involving a lower extremity amputation complicated by a severe "phantom pain." Lumbar sympathectomy was done under local anesthesia. The intact chain was stimulated electrically. So was the caudad and cephalad end of the then cut sympathetic chain and pain was produced by all. He concludes that pain sensation is carried by certain sympathetic fibers and that Daupe's theory is wrong (efferent stimuli cause pain). (Ed: Interesting, but requires further confirmation.)

BOYD and MONRO (135) present a general review of the subject of paravertebral sympathectomy. Results of lumbar sympathectomy for relief of Raynaud's disease, immersion foot, livedo reticularis, acrocyanosis, arteriosclerotic occlusion, thromboangiitis obliterans, phantom limb and hypertension are cited.

JOHNSTON (136) discusses the use of chemical and surgical interruption of the sympathetic pathways in peripheral vascular sclerosis, major and minor causalgia, the various sequelae of thrombophlebitis, hypertension and congenital megacolon. The author feels that interruption of sympathetic pathways was definitely indicated for these conditions.

LAUTRE (137) draws on experience gained in over 100 sympathectomies to offer several well-considered "do's" and "don't's" in this field regarding selection and technique. He discusses the indications for and the results that can be expected from ganglionectomy in the common and also the less-often-seen occlusive and vasospastic conditions of the extremities.

The miscellaneous discussion includes seven articles. MEYER-LAACK (138) attributes spectacular success and improvement in three cases of Sudeck's syndrome to roentgenotherapy. His first case was that of a 48 year old man with fracture of the os capitale with degeneration and alteration of the surrounding bones. He had marked incapacity extending over a period

of at least eight months. He was treated with 120 roentgens to the right cervical field, the right axilla, and the right hand. Three months later, he was given 200 roentgens. Three months after the first treatment, the pain had disappeared, function was normal, and os capitale showed x-ray evidence of consolidation and the spotty alteration of the radius and metacarpal bones had disappeared. The second case described by the author was that of a woman of 62 years who showed spotty atrophy of the patella and femoral condyle, following arthritis. She received 150 roentgens with a repetition of 150 roentgens after an interval of four weeks. Four months later function was fully restored and the spotty degeneration had disappeared from the x-rays. The third case was a 58 year old concert pianist who had a severe pseudo-atrophy of the radius. He received similar treatment and had an immediate decrease of pain with ability to play the piano in a concert six months later.

VERBIEST (139) reviews the literature concerning torticollis, and the conclusion is reached that nothing is definitely known about these mechanisms. Electromyography, partial anesthesia with pentothal, and thorough psychiatric examination are considered important diagnostic aids in differentiating between organic and functional torticollis. Three cases of spasmodic torticollis treated by cutting the upper three anterior cervical roots bilaterally and intradurally and cutting the accessory nerve either in the posterior fossa or in the neck are presented. The neurosurgeon's purpose is to modify the activity of the defective nervous system in a favorable sense by suppressing other active parts. Two cases of dystonia and choreoathetosis treated by cortical ablations are presented. It is stated that anterolateral cordotomy would have been equally justified. The author reports that the first results of these operations, both collected from the literature and from his own experience, are encouraging though far from the ideal.

TSCHANNEN and SONNENHEIN (140) discuss the theoretical effect of ultrasonic waves on arthroses and related conditions. They conclude that the action of ultrasonic results is via a primary reflex which decreases the tone of the skeletal musculature. They are of the opinion that muscular hypertonia can be considered the most important pathogenic factor for arthrosis, e.g., from the ultrasonic wave producing hypertonia of these muscles, formerly believed to be in a state of hypotonia, with resultant degeneration of the joint surface.

HUDDLESTON et al (141) report the use of electromyography in the diagnosis of neuromuscular disorders. Electromyography has three important services to offer in the management of neuromuscular disorders: (a) differential diagnosis, (b) prognosis, (c) assistance in treatment. The apparatus used in this article is described in detail.

KISSELL et al (142) experimentally demonstrate the importance of peripheral stimuli in the genesis of the "phantom extremity." A non-amputation case with total paralysis of the brachial plexus is reported.

JENSEN (143) states that psychosomatic musculoskeletal symptoms are atypical in character, anatomical distribution and radiation, and do not respond to the usual therapeutic regimes. The patients are often psycho-neurotic and may show accident proneness. The psychosomatic problems of amputees are stressed. Treatment should be given by the family doctor which

consists of rest, sedation, physical therapy and psychiatric consultation in major problems.

OVERBEEK (144) observed the curves obtained in the Everse-De Fremery test in normal and adrenalecтомized rats. Adrenalectomy caused abnormally low curves after nerve stimulation and also after direct muscle stimulation. Fatigue heightened this abnormality.

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CHAPTER VIII

FRACTURES

By

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- I. General
 - A. Treatment
 - B. Research
 - C. Complications
- II. Head and trunk
 - A. Head
 - B. Vertebrae
 - C. Pelvis
- III. Upper extremity
 - A. General
 - B. Humerus
 - C. Radius and ulna
 - D. Hand
- IV. Lower extremity
 - A. Hip region
 - B. Femur
 - C. Patella, tibia, and fibula
 - D. Foot

In this chapter, 42 articles are abstracted. Several could not be translated in time for publication and a few were not received.

General

There are four articles dealing with the subject of treatment. CLEVELAND (1) reviews the general situation in regard to the emergency treatment of bone and joint casualties as it existed in World War I and World War II. Emphasis is placed on the primary closure of wounds, forgotten between the two World Wars. The closed plaster technique, popularized in the Spanish Civil War had become a deeply ingrained surgical concept. In order to evaluate the success of delayed primary closure of wounds over compound fractures, a study was undertaken at a hospital center. During a five month period after the invasion, primary closure was attempted in 2393 patients. Complete healing by primary intention occurred in 1592 cases, or 66.5 per cent of the total. Partial failure occurred in 640 cases or 26.7 per cent. In almost all of these, healing took place before the patient left the hospital. This meant that about 93 per cent of patients on whom delayed primary closure was attempted were returned to the Zone of the Interior with healed

wounds. The success of these closures was determined by the completeness of the original wound excision. In a series of similar size in which no closure had been attempted, an incidence of osteomyelitis of 54 per cent appeared. This reduction in osteomyelitis from 54 per cent to 14 per cent by delayed closure of wounds over compound fractures, should answer the question of how these cases should be managed. Skeletal traction is the safest and simplest method of mass treatment of compound fractures of long bones caused by gunshot or high-explosive shell. Evacuation of the patient from overseas to the Zone of the Interior should be in circular plaster-of-Paris splints. Internal fixation should not be undertaken until after wound healing. There were 3190 long bone compound fractures received from the European Theatre at the 19 general hospitals in the Zone of the Interior which participated in this report. The status of healing of these fractures, four to six months after injury are as follows: 68.6 per cent were satisfactorily united, 13.3 per cent had united in malposition, and 18 per cent were ununited. Many, due to loss of bone by the wounding agent or to the overzealous removal of bone fragments, required years of repeated bone-grafting procedures to bridge a gap or loss in continuity. Wounds of the hand comprise two per cent of all wounds. From the time of injury every effort should be directed to salvaging all possible damaged tissue and to restoring function. A meticulous cleaning is important. The debridement should be done carefully so that all possible tissue can be conserved, especially viable skin. Primary closure by suture or split thickness graft is recommended. (Ed: It is believed that wounds of the hand caused by high explosive shell fragments are preferably managed by initial debridement and delayed closure on the fourth or fifth day if no infection exists.) As the art and science of surgery has progressed, amputation has diminished in frequency. The incidence of amputations in World War II was approximately one-tenth that in the American Civil War. Amputation is now resorted to only when an extremity is irretrievably damaged. For emergency amputation an open circular type at the most distal point possible is safest and most desirable. Continuous skin traction usually results in closure of the stump. The definitive amputation can then be done with greater safety later at an elective site. The major joints are frequently involved and their early management determines their later course. If there is a perforating wound of the joint, a wide surgical exposure should be done with careful excision of damaged soft tissue and cartilage and removal of all available foreign bodies and the joint cavity irrigated. The synovial membrane and capsule should be closed with instillation of penicillin into the closed cavity. The skin and superficial tissues should be left open widely and the extremity should be immobilized. After 24 hours the joint may be aspirated and the antibiotic again instilled. Closure of the superficial wound by suture or skin graft should be accomplished three to five days after wounding. The safe and comfortable transportation of the casualty with a compound fracture is of utmost importance to minimize further trauma. Emergency splints should be applied at the point of first aid. Following wound excision, the application of appropriate plaster casts, completely split to allow for swelling, are advised.

O'MEARA (2) presents his views on the safe management of fractures before the Massachusetts Medical Society. He gives a complete review of the historical advances of the past century and in conclusion recognizes the trend toward surgical management. The major surgical means are internal fixation, external fixation, and intramedullary nailing. He warns that open

management of any type is more hazardous than closed, and that the major job of the doctor is to restore function quickly and completely, if he can, but by all means, safely.

JOHNSON and STOVALL (3) report on external fixation as a method of treatment of fractures. Questionnaires were sent to all members of the American Academy of Orthopaedic Surgeons, the American Association for the Surgery of Trauma, and one of the state medical associations. From the 3082 questionnaires, 768 replies were received and 395 replies were considered for analysis and subdivided into three groups as follows: 24 per cent found this method to have a definite place in fracture management, 29 per cent found it inadvisable, except in rare instances, and 43 per cent had at one time used this method but have discarded it completely. The reasons for disapproval were: (a) as good or better results were obtainable by other methods which these physicians felt were less time consuming, less difficult mechanically, and attended by fewer of the complications of infection, (b) poor reduction, (c) poor immobilization, and (d) malunion or nonunion. The advantages listed were: (a) more secure and adequate immobilization, (b) early ambulation, (c) shorter period of hospitalization, (d) simplicity and speed of application, (e) reduction of nursing care, (f) early motion of joints, (g) the maintenance of bone length, (h) absence of nonunion, (i) absence of distraction, (j) minimum surgical risk, and (k) reduced period of time required for application. In conclusion, the authors recommend that any individual who contemplates using this method of treatment acquire special training under the supervision of an individual who has treated at least 200 cases by this method.

GDALEVICH (4) reports his results with osteosynthesis of infected gunshot fractures.

Two articles on research are abstracted. In a study of fracture healing by means of radioactive tracers BOHR and HALBORG (5) use P-32 and Ca-45 on rats to determine whether the metabolic processes are localized in the immediate area of the fracture or whether the whole skeletal system is involved. They found that the phosphorous-nitrogen ratio decreased during the first 20 days after fracture, returning to normal in about 50 days. The authors failed to find support for the conclusion of Roche and Morgue that all the bones in an animal with an induced fracture take part in the process of healing. They did find, however, that activity appears also in the metaphyseal and epiphyseal parts of the bone, even though remote from the fracture site.

SACHAR et al (6) confirm previous observations that there is an abnormal loss of nitrogen following trauma, a phenomenon usually referred to as the catabolic phase, and he concluded from his study that seven of 12 patients who incurred severe fractures showed an initial loss of sugar tolerance, which gradually was regained as the catabolic period waned, and that in six of the 12 cases changes in the sugar tolerance were sufficient to place the patient in the "diabetic" group, and that the loss of nitrogen after trauma is not associated with marked changes in the level of ketonemia as it is during fasting.

Two authors write on complications. TOURNEUX (7) reports on a lecture on venous embolism in closed fractures, outlining the differential diagnosis

between fatty embolism and venous embolism, and discussing the historical aspect of the condition, and its pathology. In agreement with Barber, the author lists five different types of embolic accidents: (a) in the syncopal type a large infarct is stopped in the right heart causing sudden death, (b) the choking peracute type when the infarct stops at the level of the trunk of the pulmonary artery: the patient is suddenly overcome by suffocation, (c) the acute asphyxial type, in which a large pulmonary infarct develops leading rapidly to cardiac failure, (d) the subacute asphyxial type, an infarct of the terminal limbs of the pulmonary artery, represented by the clinical picture of localized pain, intense dyspnea and hemoptysis and usually recovery, and (e) the undetermined type, often taken to be bronchitis.

SPINOLA (8) explains the modus operandi of displacement of fracture fragments by the uncoordinated muscle action which results from the fracture. He concludes, that to succeed in maintaining the fracture in position after reduction, the compression on the fleshy masses surrounding the bones applied through the cast, or other means, must be sufficiently intense to resist the resultant force which forces displacement of the fragments.

Head and Trunk

There were no articles abstracted on fractures of the head. Two authors write on fractures of the vertebrae. ROCHE (9) reports a case of bilateral fracture of the pars interarticularis of the third lumbar neural arch, without dislocation, in a 22 year old man, whose jeep overturned. He was immediately placed on a Stryker frame and roentgenograms showed the fractures involving both isthmi of the third lumbar neural arch, without dislocation of its vertebral body. The period of recumbency was 17 weeks. Roentgenograms at the end of that period showed obliteration of the fracture lines. The patient was re-examined 26 months after injury. He had worn a Taylor brace for six months following the recumbency, had been regularly employed at clerical work and had no symptoms. Roentgenograms demonstrated healing of the bone.

FISHER and MAXWELL (10) suggest a simplified method for treatment of compression fractures of the lower back. The patient is suspended prone by a Zimmer clavicular strap applied about the shoulders and a stout rope quadrupled, is attached to a ceiling fixture. The patient's head is held in the anesthetist's lap to maintain an adequate airway. The patient's thighs and arms are supported by tables or assistants. The operator may manipulate the back by placing his right knee under the symphysis pubis, the left hand under the sternum and reducing the fracture with the right hand. A light, snug-fitting plaster cast is applied. The method is simple and cheap.

Pertaining to pelvic fractures, CORRADI (11) describes a vertical fracture extending from the top of the sacrum to the distal end of the coccyx; vertical fractures of the right and left ischiopubic junctions; subluxation of the symphysis pubis with upward displacement of the left ramus. The traumatic mechanism which caused the fracture is considered by the author to have been the impact against knees transmitted through the femurs and resulting in a disruption of the pelvic girdle and a giving away of the sacrum.

Upper Extremity

The one article on the upper extremity in general is by SCHWARTZ and HARMON (12) who report on their experiences in the treatment of 30 fractures of the shafts of the long bones, chiefly the humerus, the forearm and the tibia, utilizing medullary fixation by threaded wires and pins of various sizes of 18-8 SMO stainless steel. The diameters of the pins used ranged from 1/8 inch to 7/32 inch and from six to 15 inches in length. The authors discussed the techniques used for individual bones. The results as stated by the authors are quoted as follows: "There were no instances of nonunion and no infections. Solid union to physical examination was often present in 12 weeks."

In a discussion of fractures of the humerus BOSWORTH (13) proposes the use of blade plates for fractures of the surgical neck. He states that in the past, treatment of these fractures has consisted of essentially no treatment whatsoever. He agrees that many, perhaps most, such fractures are not displaced sufficiently to demand replacement, progress uniformly to union and provide a stable and useful extremity when united. His attention was first directed to this problem by a patient in whom osteotomy was necessary for congenital humerus varus. A regular vitallium plate sharpened on one end and bent to the proper angle was used. The second case concerned a displaced fracture of the surgical neck of the humerus in a laborer, impossible to reduce by closed methods.

SMITH (14) discusses medial epicondyle injuries and states: (a) injury to the medial epicondyle of the humerus is common, but it is not usually a serious injury, (b) the most important diagnostic point to remember is the possibility of displacement of the medial epicondyle into the elbow joint, (c) all epiphyseal ossification centers must be discernible in their normal locations by roentgen examination, (d) treatment should be based upon the conditions present and should be instituted early. Conservative treatment is indicated in all cases except those in which intraarticular displacement of the epicondyle has occurred or in which ulnar nerve damage has taken place, (e) the physician should minimize the period of immobilization and institute early active exercises within pain limits, (f) the physician should avoid prolonged immobilization, passive stretching, weight carrying, and late operative treatment, (g) the status of the ulnar nerve should be checked before treatment and frequently during treatment (the nerve should be treated if indicated), and (h) the prognosis for this injury is excellent if the condition is treated early and wisely and is not overtreated.

In the treatment of fractures of the radius and ulna, SALASC (15) presents a case report of a fracture of the olecranon process treated by excision of the one and one-half inch fragment. After immobilization in a light plaster cast for 48 hours, freedom of motion of the elbow was allowed. Five months after all the elbow movements were normal.

PATINO (16) presents his method of fixation of compound fractures of the middle third of both bones of the forearm. Plates with screws are considered intolerable. Thin wires placed longitudinally do not prevent displacement in an anteroposterior direction. The author prefers, in the management of exposed fractures, treating the wound area and fracture site with penicillin, and immobilization with a Clayton type splint for about 72 hours. If infection is under control at this time, surgical reduction is made and osteosynthesis of the radius is accomplished with a thin silver wire. In

addition two Strader duraluminum and steel nails are inserted for external fixation.

CASSEBAUM (17) reviews 361 patients with Colles' fracture and the end results in 81 cases. All the patients studied were treated by manipulative reduction and plaster splints. Badly comminuted and oblique fractures are difficult to reduce and still more difficult to hold. Since this study, the authors more frequently use splints immobilizing the elbow. Permitting elbow motion is a frequent cause of motion at the fracture site, with consequent loss of position. In their experience immobilization in marked palmar flexion results in a painful, prolonged convalescence. Dorsal tilting is one of the most pronounced anatomic deformities of Colles' fracture, but is the least disabling. Radial deviation of the wrist and shortening, with the resultant disturbance in the radiolunar joint, are greater functional handicaps. Pain or aching associated with changes in the weather not infrequently persists for as long as a year after severe Colles' fracture. Wringing clothes, turning a tight door knob, heavy lifting and pronation and supination movements under stress are frequently painful for a year after injury. Happily, few patients have pain after this time even when they retain considerable deformity. The following are common violations of principles: (a) rocking the fracture back and forth to break up the impaction, an action which further comminutes the fracture and injures the soft tissues, (b) application of splints without anticipation of further reactive swelling and edema, (c) neglect of shoulder and finger exercises, (d) inadequate immobilization due to poor splints or too brief a period of immobilization (under five to six weeks in patients with deformity), (e) immobilization in marked flexion, which position is painful and interferes with circulation, and (f) failure to make the patient understand the importance of early function of the fingers.

In fractures of the hand ROEMER (18) describes two types of hyperextension injuries to the finger joints, and concludes: (a) the common "baseball" or "mallet-finger" is frequently due to forceful hyperextension of the distal phalanx on the middle phalanx, (b) a similar injury occurs at the insertion of the middle slip of the extensor tendon at the middle phalanx. This results in a typical and very disabling type of deformity, the differential diagnosis and treatment of which is described, (c) spicules frequently seen in x-ray on the volar aspect of the interphalangeal joints resemble sesamoids but are usually avulsion fractures at the distal attachment of the joint capsule due to hyperextension or a direct crushing force.

O'CONNELL (19) reports on an unusual compound fracture. A milkman on a delivery tricycle was involved in a collision with a similar vehicle. His left hand resting on the handle bar was driven forcibly against the bell which was fixed to the bar. Radiographic examination showed that the lever of the bell had penetrated the lateral cortex of the neck of the second metacarpal. The bone cavity was curetted and 500,000 units of penicillin solution were instilled into the wound. Three weeks after the injury the wound was firmly healed. Flexion of the metacarpophalangeal joint was limited by 10 degrees but other joint movements were normal.

Lower Extremity

In an article on fractures about the hip region, LEWIS et al (20) pre-

sent their observations and conclusions based upon a study of 152 consecutive patients with intracapsular fractures of the neck of the femur. All cases were treated by nail fixation. Of the 106 patients who could be followed for at least a year, 79 (74.5 per cent) obtained union. The authors consider that the occurrence of late aseptic necrosis of the head of the femur has been very infrequent, and they conclude that, to avoid nonunion,^{*} the reduction must be good, the nail must be long enough to reach well into the head, the fragments must be well impacted, unsupported weight bearing must not be undertaken for six months, and the operation must be performed only by experienced surgeons.

KOLE (21) describes a sighting mechanism for placing the guide wire in the neck of the femur during the operation for internal fixation of a fracture of the neck of the femur. The fracture is reduced by manipulation. The axis is arranged by application of Jeschke wire net and x-rays are taken at both levels. Nails are then inserted to mark the head of the femur and a third nail in line with the two preceding nails is placed in the shaft, one inch below the tip of the trochanter. An incision is made to expose the area of the greater trochanter; one sees the third nail lying alongside the lateral surface of the femur. Where this nail touches the femur is the exact point at which the guide wire must be introduced. The assistant inserts the Kirschner wire by hand by sighting on the first and second pins. It is determined by x-ray that the guide wire is in good position and the Boehler nail is driven in. The author states that the actual length of the operation, including the taking of x-rays is about 25 to 30 minutes. (Ed: The original article contains a drawing of the Jeschke net superimposed over a diagram of the upper end of the femur.)

DE PALMA (22) presents a preliminary report on 40 consecutive cases of transcervical fracture of the neck of the femur which conform to Pauwel's Types II and III. Wedge osteotomy through the neck of the femur is offered as a simple and effective procedure for converting sheering forces of the fracture site into compression forces. The lower incidence of aseptic necrosis may be due to the rapid healing process that takes place at the fracture site when the femoral head is placed and fixed in the position of valgus. Longer follow-up studies are necessary before the final incidence of capital necrosis can be established.

MILLER (23) reports a case with stress fractures of the necks of both femurs in a white stenographer, age 36. She complained of pain in both hips for two months. The patient walked with the hips flexed, the pelvis tilted backward and both lower extremities held in adduction. Attempts at abduction of the hips produced pain in the inguinal region on each side. Anteroposterior roentgenograms of both hips showed an area of dehiscence extending through the inner aspect of each femoral neck at approximately the point exposed to most stress. The fracture line was widest at its innermost point and gradually faded. Hubbard-tank baths and general massage gave immediate relief and she was allowed to bear weight with crutches for three months. In eight months the patient was free from all symptoms and had returned to work. Anteroposterior and lateral roentgenograms of both hips showed complete healing.

PETERSON (24) in a comprehensive survey of the literature, could find reports on only 13 cases of simultaneous fractures of the neck of the femur

and dislocation of the femoral head. One of the cases was reported by Funssten et al. The other case was reported by Hart. In this paper, two additional cases are presented; one is a personal case, and the other, which has not been reported previously, was contributed by a colleague, J. A. Freiberg. The author's case is reported in detail with an evaluation of the result after a period of seven years. The prognosis of unusual injury is far less favorable than that in other types of fracture-dislocation involving the hip. The author chose to reduce the fracture and to insert a graft. Removal of the femoral head followed by a reconstruction operation is the treatment of choice. Available reconstruction measures are as follows: (a) insertion of the neck, (b) primary fusion, (c) trochanteric cup arthroplasty, and (d) primary replacement of the head by a device such as a metallic prosthesis.

LEVENTHAL (25) reviews 20 cases of intertrochanteric fracture of the hip treated on the Orthopedic Service of the University of Pennsylvania Hospital. He agrees with Cleveland, Bosworth, and Thompson that these patients, in spite of their age and poor physical condition, withstand anesthesia and surgery surprisingly well. The mortality rate is definitely lowered. Internal fixation of the fractures facilitates postoperative care and reduces the incidence of serious complications.

RIENUNAU (26) states that he has used Jewett nails very successfully in intertrochanteric fractures of the femur. He mentions the seriousness of these fractures, quoting the 30 per cent mortality rate published by Mather Cleveland and Norton, and implies that thromboembolism has been found to be a major causative factor in this high mortality. He further remarks that preventive ligation of the femoral vein (Norton, Linton) to prevent any embolism is an advance in the management of these cases.

SCHEIDT (27) discusses the so-called "plug fixation" method of providing internal fixation for pertrochanteric fractures of the femur advocated by Hauck and Bako. The method consists essentially of the placement of two to four wires across the fracture site, leaving the wires protruding from the skin. The method has two serious disadvantages: first, the danger of infection, and second, likelihood of displacement of the fracture. In an effort to improve the results the author modified the technique, essentially by having the wires lie subcutaneously. A plaster spica is then applied. (Ed: This appears to be a local controversy. The author points out that the idea was not originated by Hauck and Bako because Moore had used three nails for the same purpose.)

VAN HOVE (28) reports a detailed study of an isolated fracture of the lesser trochanter in a patient, age 14, who incurred the fracture while running, after which he walked home. Two years after the accident, running was still not normal and he tired easily. In a review of the literature, the author found 64 other cases. From the background of the literature, the etiology, pathological anatomy, pathogenesis, differential diagnosis, treatment, and prognosis are discussed.

MARCHAND (29) reviews his methods of management in 150 fresh fractures of the femur in children. The methods used were as follows: 19 reductions by continuous horizontal extension; 90 reductions by continuous vertical extension; six reductions by traction applied with a Kirschner pin; 23 surgical reductions with a metal plate; seven reductions by centro-medullary

piercing with a Steinman nail; one case of internal fixation with a screw; and finally, five fractures were immobilized by means of a plaster cast. 37 per cent were graded as excellent, 50 per cent as good, and two per cent as poor. Hospitalization lasted on an average of 29 days for closed reductions, 22.2 days for fractures internally fixed with plates, and 19.3 days in the cases of centro-medullary piercing. Current practice is vertical extension for children six years old and under. With the older children, horizontal traction is used with or without the Kirschner pin. The medullary nail is preferred in fractures of the upper third, while plates are chosen when the fracture is in the medium-low or definitely low diaphyseal fractures. The intervention is followed by immobilization in a cast for six weeks. The Steinman nail is removed after about six weeks; embedded plates are removed after six months.

PETERSON and REEDER (30) discuss the use of dual slotted plates in fixation of fractures of the femoral shaft and report on 18 cases treated by this method. Internal fixation of fractures of the femoral shaft by two slotted plates is advocated for the treatment of fractures in which internal fixation is indicated for malposition, nonunion, or malunion, or in which open reduction is the treatment of choice. The report includes a series of 18 fractures which were treated successfully by this method. The absolute rigidity and contact established by two slotted plates make it possible to dispense with external immobilization, and the patient may bear weight without restriction as early as a week after the operation.

SMITH (31) discusses intramedullary fixation. In October, 1947, the Surgeon General's Office, Department of the Army, authorized a substantial grant through the National Research Council for an extensive clinical investigation of intramedullary fixation. More than 18 months were consumed in designing and redesigning pins and instruments which were mainly modifications of the ideas of Kuntscher, Habler, Hansen, Street, Bohler, and others. All efforts were concentrated on improving the equipment for the femur. In June 1949 complete sets of intramedullary equipment either for the diamond-shaped pin or the clover-leaf pattern were considered adequate and were distributed by the Army to 20 groups of investigators; three to the Army general hospitals, two to veterans facilities, and 15 to civilian groups. As of January 1, 1950, 398 intramedullary pins had been inserted. A detailed analysis of cases will be carried out at a later date. (Ed: The final report of this group was in the form of a Symposium of 700 femurs in Instructional Course Lectures, American Academy Orthopedic Surgeons, 1951, J. W. Edwards Co., Ann Arbor, Michigan.)

STREET (32) compares treatment of fractures of the femur by skeletal traction, dual plating, and medullary nailing. He begins the discussion by stating that treatment of fractures in the femoral shaft has undergone a process of evolution in which the five main mechanical principles have been developed. The oldest method, that of reduction by manual traction and manipulation, followed by external fixation was extensively employed by Hippocrates. The second method, that of continuous traction, was introduced by de Chauliac about 1350. The third method, that of open reduction with wire suture fixation was attempted as early as 1827 by Rogers. The fourth method, external skeletal fixation was originally employed by Bonnet about 1870. The fifth method, medullary nailing, is a form of internal fixation. The author conducted a study of a series of 20 cases and concluded that skeletal

traction, dual plating and medullary nailing are the three most promising methods. Hospitalization and total disability are shortest with medullary nailing, which is recommended as a treatment of choice in suitable fractures of the femoral shaft.

VAN DE VOORDE et al (33) report a case of pseudarthrosis of the femur treated by intramedullary nail and graft.

In consideration of fractures of the patella, tibia, and fibula, the general principles of fractures of the lateral tibial condyle are reviewed by BRADFORD and KILFOYLE (34) and they add a "therapeutic classification." They believe that the basic mechanism for all fractures of the lateral tibial condyle is an impaction of the condyle of the femur against the plateau of the tibia, as a hammer strikes an anvil. In their series of 40 cases, three general types were encountered. Type I, the "crush fracture," consists of all degrees of compression of the lateral tibial condyle with mild or extreme depression of the plateau. In Type II, or the "split fracture," the condyle, instead of being crushed, is split off with little, if any, depression. In Type III or "shatter fracture," the force of the trauma extends obliquely toward the center of the knee and downward, to break away the support of the shaft or of the medial condyle at the neck of the tibia. The authors concur in general that only those cases with over one-half inch of depression should be considered for open reduction. The results of surgery are apt to be disappointing and conservative treatment will give satisfactory results "even when considerable irregularity of the condylar tables persists." The principles of conservative treatment, followed by the authors, have been worked out in detail. First a manipulative reduction is done under anesthesia. The knee is drawn forcibly into varus and with a well-applied cast, which must extend from the groin to the foot. The knee must be forced into enough varus to protect the lateral plateau from compression; this position must be maintained for approximately four months and nonweight-bearing motion must be started early to avoid stiffness of the knee. That is, in 10 days to two weeks, moderate flexion movements are started actively but not passively. The exercises are repeated twice a day, the amount of motion being increased as fast as the patient can tolerate it. The limb is replaced in the cast after the exercise. By the third or fourth week, the patient can be transferred to a high-thigh, double-upright brace, equipped with straps to maintain varus support. For these cases, the operative procedure is so extensive that it involves more than the ordinary risk of infection. The literature is remarkably free from any mention of this hazard, but, even with antibiotics and chemotherapy, the risk remains grave. If the displacement is gross, with fragments large enough to permit some form of internal fixation, the advantages of open reduction probably outweigh the risks of surgery.

PIQUE (35) discusses the principal indications for use of bone grafts in fractures of the tibial tuberosities. When the fracture is not displaced, the nonsurgical methods offer a satisfactory solution. According to the author, there are three types of displacements: lateral, compression of spongy bone, and a combination of the two. Nonsurgical reductions were done by manipulation and lateral compression with Bohler's clamp, Delitala's pres-sers, Cotton's hammer, Roux's forceps, etc. In eight of the author's series of 13 cases, the menisci were ruptured. The author reports satisfactory results in all 13 cases.

ROCHET (36) provides a six year follow-up on a case of partial patellectomy for fracture in a 59 year old woman. Range of knee motion was complete. The author believes that the smaller fragment should be sacrificed whether it is the upper or lower one. Partial patellectomy prevents the formation of the enormous patellae that sometimes form after the best repairs. Tavenier, in discussing this paper, made the following remarks: "I am in agreement with him with regard to removing always the smallest fragment; it is when the fragments are even that I advise removing the upper fragment in order to maintain the normal insertions of the patellar ligaments." Scott, an English Surgeon of the Royal Air Force, reported that "It would appear that the results of total patellectomy, although favored by certain English surgeons, are far from satisfactory, that those achieved through suture are better, and that the results of the removal of one of the fragments is much better."

STRAYER (37) provides a background discussion on spastic contracture of the calf muscles and describes his operation of resection of the gastrocnemius muscle and the results of eight cases. Tenotomy of the tendo achillis is one of the oldest procedures in the surgical heritage of orthopedic surgery. Stoffel outlined a method of denervating spastic muscles. The author's impression, gained from examining patients who have had heel-cord lengthening and the Stoffel procedure, has been one of disappointment. In case I it was found that, with the knee in 90 degrees of flexion, the foot could easily be dorsiflexed to 90 degrees. This demonstrated that severance of the gastrocnemius from the soleus would allow the patient to place his heels on the floor when walking. Since beginning this work, he discovered that Silfverskiold presented a paper on this subject in 1923. The eight cases in detail by the author all resulted in the patients being able to place their heels on the ground during weight bearing. The operative procedure was given in detail. The immediate operative result desired has been obtained in all cases so far treated. Following the operations, the relaxation of the scissor gait was marked. In similar fashion these patients were able to use their gluteii and to contract them while in the standing position which they had not been able to do before. This change in the tonal reflex of these muscles is so fundamental that the patients recover active dorsiflexion of the foot by means of the anterior tibial muscles, which had usually no voluntary control previously.

LAUGE-HANSEN and RANDERS (38) report findings in experiments in the production of fractures of the ankle. The authors determined the mechanism of fracture, the pathologic anatomy, and the genetic roentgenology. The experiments were carried out exclusively on extremities which were amputated at the femur or at the knee.

In consideration of fractures of the foot, WILSON (39) discusses his methods of treatment of fractures of the calcaneus. Included also is a thorough discussion of the various roentgenographic views which are helpful in making an exact diagnosis of the character and extent of the fracture of the calcaneus. The author deprecates any operative attempt to replace the fragments of a compressed fracture of the calcaneus in view of the great number that may be present. The introduction of pins is also considered objectionable since they are apt to produce a distressing osteomyelitis, very difficult to cure. The object of treatment should be to restore, as far as possible, the facets to their normal position and this can be accomplished

best by closed methods. The setting is a combination of simultaneous traction, pounding and lateral pressure, and is carried out with the aid of fluoroscopy, while assistants exert a strong simultaneous pull and the surgeon delivers a heavy blow on the felt padded brown handle with a four pound mallet. The blow disimpacts the fragments. When satisfactory reduction has been accomplished, he can proceed with plaster-of-Paris with the patient prone so that he can compare it with the opposite side. Stockinette is pulled over the foot. A thick piece of sponge rubber is then placed immediately beneath each malleolus and over this plaster is applied. The cast is left on for a month. The patient is encouraged to move the foot in various directions many times a day. The patient should not bear weight on the limb, however, for about eight weeks and then only with the help of crutches and a fairly stout shoe.

GECKLER (40) discusses fractures of the os calcis. In a review of 100 cases it was found that the average time lost from work was 18 months, with an average payment of \$1,561 for compensation during that time. The author reviews his own cases and expresses his opinion as to how the cases should be managed. The cases are divided into Types A and B. In Type A the fractures do not involve an articular surface; while in Type B the one or more articular surfaces are damaged. Fractures in which the heel is not decidedly displaced need no manipulation. Treatment is early weight bearing in a walking cast, the foot being held in a decided equinus position. More severe injuries, with loss of the tuber angle and marked squashing and tilting, must be treated by reshaping. For fractures which extend into the calcaneocuboid joint a triple arthrodesis is indicated. In 27 cases of fractures of this type and with this treatment, the author reports good in 19 cases (70 per cent), fair in eight cases (30 per cent), and poor in no cases.

MICHELE and KRUEGER (41) give a short discussion of the treatment of fractures of the astragalus and cite two cases. They advise roentgenograms of both feet to identify an os trigonum. They also advise immobilization of the foot at a right angle for four weeks where there is a mechanical interference of the subastragaloïd joint. Excision of the entire posterior process of the astragalus is indicated. Both of the cases cited were treated by removal of the displaced fragment. Follow-ups of five years and two years respectively found that the ankles in both cases were functioning normally and without discomfort.

VECCHIONE (42) discusses the incidence, causative mechanisms, and treatment of isolated fractures of the tarsal navicular and the cuboid and cites three cases. Two were of the navicular, and one of the scaphoid. In each case, crushing by falling objects was the causative factor. Treatment consisted essentially of immobilization in plaster casts. Long term follow-ups were not included.

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CHAPTER IX

FRACTURE DEFORMITIES

By

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Assisted By

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- I. Consideration of fracture deformities in general
 - A. Review of literature
 - B. Treatment of bowlegs
 - C. Intramedullary nailing
- II. Bone grafts
 - A. Preservation
- III. Regional fracture deformities
 - A. Upper extremity
 - B. Trunk
 - C. Hip - arthroplasty
 - D. Hip - other procedures
 - E. Femur
 - F. Knee
 - G. Tibia
 - H. Ankle and foot

There are 51 articles abstracted for this chapter. Translations for some of the foreign articles are not available.

Consideration of Fracture Deformities in General

BARBER (1) continues the review of the literature of 1946 relative to the advancement made in the treatment of serious complicated injuries and diseases of the myoneurokeletal system. The subjects covered in this section are early treatment, penicillin therapy, infected bone defects, osteomyelitis, upper extremity lesions, injuries to the jaw, pseudarthrosis of the clavicle and post-traumatic contractures.

Bowleg deformities are still being treated by manual osteoclasis. BROCKWAY (2) treated 32 patients between the age of 18 and 24 months with bowleg deformities by the manual osteoclasis method and obtained satisfactory to excellent results in all cases.

In the treatment of deformities of the joints, LUGIATE (3) writes of the use of Marziani's dentate osteotomy.

Intramedullary nailing of fractures is discussed by five authors. DELITALA (4) reports the use of a V-shaped intramedullary nail designed to bridge the gap of a defect in a long bone of the extremities, usually in association with a bone grafting procedure. The nail is inserted at the fracture site and is intended to remain permanently. After insertion into one fragment, it is driven into the other by means of a special driver which fits into openings in the nail. Progress is made by moving the driver through consecutive openings as the nail advances.

MACH (5) discusses the sequels of osteosynthesis by metallic prostheses by Kuntscher's method. DURAO (6) discusses osteosynthesis by metal removable prosthesis. AIMES (7) also writes on the subject of osteosynthesis.

MAKHLLOUF (8) briefly reviews medical and surgical treatment of pseudarthrosis. He mentions the limitations and feels that the medullary nailing of Kuntscher is the best method. He cites three of his cases with excellent results.

Bone Grafts

Preservation of bone transplants and their use in surgery is the subject of a paper by SICARD and BINET (9). A total of 205 frozen homogenous bone grafts have been used by the authors with seven infections (3 per cent) and only three operative failures. In 100 autogenous fresh grafting procedures under similar circumstances there were five cases of suppuration and one loss of the bone graft. The authors conclude that bank bone (frozen and homogenous) is well tolerated and that the behavior of this bone radiologically, clinically, and physiologically is the same as that of fresh autogenous bone.

REYNOLDS and OLIVER (10) believe that no elements of an autogenous bone graft survive or retain osteogenetic powers. Fixation and replacement of both autogenous and homogenous bone are accomplished by appositional growth of bone from the host. "Creeping substitution" is a localized phase of this process. Although the earlier phases of bone healing are slightly more rapid and uniform with autogenous bone, at the end of ten weeks, there was no microscopic difference between the two types of grafts and complete replacement was present in both. Merthiolate preserved bone and frozen bone were indistinguishable experimentally.

VELASCO (11) reports a series of 128 operations with the use of preserved homologous bone. There were only 11 failures (8.6 per cent) and the author feels that the healing of bank bone grafts is similar and equally as effective as autogenous grafts.

A paper published by HORWITZ (12) in 1947 in *Surgery, Gynecology, and Obstetrics* on the fate of grafted bone is translated into Spanish.

LeCOCQ et al (13) report the results of a series of bone grafting procedures with the use of frozen homogenous bone. There was an infection rate of four per cent in the 74 patients so treated. An end-result study of 56 cases indicates failures in only 14.3 per cent of the patients and all failures were in attempts to produce lumbosacral fusion.

JAMES (14) writes a short article for nurses on the bone bank.

Grafting of homogenous bone and cartilage is discussed by CHRISTIE (15). The history of use of bone and cartilage grafts and bone and cartilage banks is reviewed. Nine cases of bone graft utilizing a bone bank in which bone is preserved in penicillin sulfathizole solution are presented. A good bibliography is listed.

HANCOX (16) describes how chick embryo bone was grafted to the chorio-allantoic membrane of other embryos, and the results were observed both visually and photographically. Bone trabeculae appeared within three days and the grafts were healed within five to seven days. It seemed apparent that the vascular pattern in the membrane determined the pattern of the trabeculae. The author notes that this bone healing occurred in the absence of a nerve supply, there being none in this membrane. The findings suggest that further, more extensive, studies may demonstrate conclusively that the deposition of trabeculae is independent of nerve supply and dependent on vascular pattern.

TOUHEY (17) reviews 74 cases in which bone grafting operations were performed. 75 per cent of these were compound fractures and 63 per cent were caused by perforating enemy missiles. In from one to two weeks after the wounds had healed, the patient was considered ready for grafting. In the repair of non-union in the shafts of long bones, the grafts were taken from the tibia in 71 cases, and from the ilium in only three cases. The types of grafts employed were: tibial onlay, 55; tibial inlay, 11; intramedullary, 5; and iliac, 3. In the femur six cases were repaired with onlay graft and metal plates, the grafts being placed on the lateral aspect of the femoral shaft, and the plates being placed on the anterior surface of the shaft. Touhey stresses the necessity of a tourniquet, even if a Steinmann pin has to be driven into the greater trochanter to hold it up. Patients were immobilized in a double plaster spica for 12 weeks and then fitted with a caliper brace. Touhey suggests the posterior lateral approach to decrease knee stiffness. Union took place in all six cases. In the tibia there were 11 cases with onlay grafts and plates with three failures with non-union and osteomyelitis. The author strongly advises the use of lateral and posterior surface of the tibia for the graft and plate. For the humerus double onlay grafts with multiple chips and plaster spica for three months was the technique used. He stresses necessity of changing the spica at time of suture removal. There were 15 cases with four failures. In the forearm there were four failures out of 25 cases. The author points out the necessity of placing grafts so as to not interfere with pronation and supination and further points out that the lower ulna shaft is not necessary for good wrist function, and resection of the lower ulnar fragment instead of grafting may be carried out. In the hand and foot there were 11 cases with 100 per cent union. Two cases of grafting of the clavicle were failures.

KEITH (18) writes on the science of grafting, and FARINA (19) discusses the principles of bone grafts.

Three cases of autogenous cartilage grafting procedures performed in growing children are described by DUPERTUIS (20). These patients were again observed at periods of four, five, and six years following surgery and in each case it was found that the cartilage had grown approximately 0.6 centi-

meters. The author concludes that use of growing autogenous cartilage grafts for the correction of contour deformities in children will encourage earlier restorations which may well be permanent.

The history of the use of transplanted homogenous bone is reviewed by HARMON (21). The author used homogenous bone preserved in a deep freeze or refrigerated in a solution of aqueous merthiolate in 131 cases. No bone was preserved longer than three months. Four of the author's cases are described and illustrated. The advantages and disadvantages of homogenous bank bone are discussed. In his series there was an infection rate of 3.8 per cent as compared to no infection in 103 cases of autogenous grafts over the same period. The author feels the advantages of bank bone lie in its use to lessen the trauma of surgery and shorten hospitalization time where needed and in its use in spinal fusion where large quantities of bone are required.

HERBERT and PAILLOT (22) report their experiences with 60 cases of frozen homogenous bone grafts used in orthopedic procedures. They maintain that these bone bank grafts behave exactly the same as autogenous bone grafts both radiologically and by sections taken at the time of re-operation in three cases. Proof of the vitality of such grafts is demonstrated by their ability to heal when postoperative fracture of the graft has occurred.

BOHLER (23) describes the use of bank bone in the bridging of bone defects in 99 patients. The advantages of having such bone available for use in extensive bone replacement are discussed. The end results are not available as yet.

SICARD and BINET (24) report their results in a series of 203 bone grafts using frozen homogenous bone. In the entire group there were seven infections, with all others going on to primary healing and bone union. The seven infections were in cases of lumbosacral fusion. The conclusion is that frozen homogenous bone is equally as effective as autogenous bone grafts.

CLYBOURNE (25) gives a brief review of the principles of bone grafting.

HYATT (26) reviews some of the literature on preservation of bone with emphasis on refrigeration of bone at -15° and the effects of refrigeration on bacteria and malignancy. He also reviews the mechanics of the merthiolate bone bank and feels that the use of frozen bone grafts is of noteworthy value with decreased operation time and less postoperative pain.

Regional Fracture Deformities

In discussing the upper extremity, MARTIN and GERMAIN (27) give a short report on the treatment of pseudarthrosis. SIFFRE (28) reports a patient who developed late ulnar palsy following resection of the radial head for an irreducible dislocation occurring as part of a Monteggia fracture.

SICARD (29) describes a case of fracture of the shaft of the humerus which was treated by open reduction and plating. Three months later the patient developed signs and symptoms of radial nerve weakness and at five months paralysis was complete. X-rays revealed a bony tunnel surrounding the involved nerve. This tunnel was removed at surgery and membranous tissue placed around the nerve. 18 months later there was excellent recovery

of nerve function.

Treatment of neglected dislocation of the distal radiolunar joint is discussed by KIRSCH (30).

VERBEEK (31) reports his method of fascial arthroplasty of the elbow and the results obtained in a series of six patients. Four results were satisfactory. In one case the range of motion was inadequate and in another there was an unstable elbow joint.

Under trunk, WAHREN (32) discusses the etiology of the deformity of the thorax known as "funnel chest." Older methods of correction are described and a case treated by rib resection and sternal elevation is reported. A tibial bone graft was placed transversely behind the sternum to maintain the correction.

A technique for spinal fusion utilizing multiple small bone grafts (homogenous) from a refrigerated bone bank is described by TOUMEY (33). He states that the use of refrigerated bank bone has definite advantages over the use of autogenous bone obtained at the time of operation.

TROUCHET (34) reports his very satisfactory end results in a series of 20 spinal fusions by the Wilson technique with the combined use of bone grafts and metal plates.

JUDET and JUDET (35) report the use of an acrylic prosthesis in conjunction with lumbosacral bone grafting. The prosthesis is fixed to the lower lumbar spinous processes and to the posterior iliac wings. This eliminates the lateral and rotary movements which the authors feel are not prevented by the H type of lumbosacral grafts and the percentage of postoperative pseudarthrosis is thereby decreased.

Treatment of moderate pelvic deformities is discussed by CLIVIO (36).

BONOLA (37) reports a simple case of a vitallium mold arthroplasty of the hip. Operative technique is briefly described.

BURKLE de la CAMP (38) discusses various methods of arthroplasty in a series of 184 cases involving the elbow, hip and knee joints. Good results were obtained in 99 patients with some improvement in 71 others.

HEPP (39) presents in detail the indications, operative technique, complications, and end results of a large series of vitallium cup hip arthroplasties. The results are divided into groups as to type of pathology and degree of operative improvement.

CHAPHAL (40) feels that his three year end results in 45 vitallium cup arthroplasties show that the operation is well worthwhile, although the series is too small and the follow-up too short for a definite conclusion to be of true value.

In considering other procedures of the hip, boring of the femoral neck in coxarthrosis deformans is discussed by HUWYLER (41) in a brief article.

STRACKER (42) describes the various etiologic and pathologic varieties of hip joint disease, dividing them primarily into types with normal configuration and types with distortion of the hip joint. Methods of treatment including the use of plastic hip prostheses are briefly discussed.

STONE (43) discusses the method of fixation of high femoral osteotomies by means of a vitallium plate. This requires no special equipment or roentgenologic control. Early ambulation with crutches is possible in most cases in less than four weeks.

BELENGER and VANDER (44) have studied a series of 104 cases of fractures of the shaft of the femur and have investigated the ensuing complications. Eight cases were treated by open reduction and ordinary fixation. Three had Kuntscher nails inserted. Complications included: pain, persistent knee swelling, equinus deformity, shortening, external rotation deformity, limitation of knee motion, atrophy and edema. It is concluded that properly applied traction suspension is in most cases the most satisfactory treatment in keeping complications at a minimum.

In discussing the femur, McCARROLL (45), after recognizing the more recent trends in equalizing leg lengths by arresting or retarding epiphyseal growth, describes, with brief technical details, the procedures used by earlier workers in performing femoral lengthenings. He then describes in greater detail the various technical procedures used by Dr. Leroy C. Abbott in the first 26 of the 37 such femoral lengthenings performed at the St. Louis Unit of the Shriners Hospital. The various faults and complications of the procedures attempted are outlined, lack of control of the osteotomized fragment ends proving to be the most consistent major problem. This analysis and his own experience developed a procedure which he describes whereby a blade plate, inserted into the femoral neck, controls the fragment ends following the osteotomy. The shaft of the blade plate is slotted for its entire length, and this slot is placed over two screws inserted into the proximal end of the distal fragment. In summary, the author states that "the operation for femoral lengthening is a serious undertaking" and outlines strict prerequisites for indication of the procedure. He states that the "complications are so numerous and the prerequisites are so exacting that few patients can be classified as suitable for this procedure.".

BRUCKE and MOSER (46) describe a fork-shaped osteotomy procedure which is designed to provide stability and impaction when applied to the correction of femoral deformities.

One report on arthrodesis of the knee is given by SARROSTE (47) who gives his results in 22 patients treated by a cruciate bone grafting procedure. The grafts are obtained from the region of the greater trochanter. Of 21 patients who have had a long enough postoperative course for evaluation, all have had successful fusions, without complication. Fusion occurred in from four to six months.

Bridging tibial defects is the subject treated by two authors, one of whom, MILCH (48), describes and illustrates an operation and presents a case history of the same. Essentially, the operation consists of turning laterally upon the interosseous membrane anterolateral longitudinally quadrants of the two tibial fragments with periosteum attached. A longitudinal antero-

medial section of fibula is then removed and is used in conjunction with iliac bone to create a lattice between the two exposed marrow cavities for the establishment of a synostosis between the tibial fragments and the fibula. Milch feels this procedure affords a supplemental method of treatment of tibial defects, finding its best use in large defects involving the middle third of a tibia in which repeated grafting has failed. It has the advantages that the extensive area of bony contact produces a greater likelihood of a solid union; it is a one stage operation. The uncut portion of fibula is an excellent stabilizing factor and is still available for future procedures in the event of failure of this procedure.

The results of treatment of osteomyelitis and nonunion of tibia fractures due to war wounds by sliding tibial grafts are presented by WALLACE (49). These operations resulted in postoperative infection in 13 but with eventual bone and wound healing in all but two cases. The author concludes that this method is superior to other types of bone grafting methods which require use of internal metallic fixation, more overloading of tissues, and more extensive surgery.

In fracture deformities of the foot and ankle VAN de VOORDE et al (50) discuss the complications of ankle fractures and review the treatment by means of physical therapy, operative correction, bone grafting and arthrodesis.

ENDER (51) believes that, in severe fractures of the calcaneus with depression of a large fragment and interruption of the subastragalar joint surface, elevation of the fragment with filling in of the space by some graft is the treatment of choice.

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CHAPTER X

TUMORS OF BONE AND SOFT TISSUES

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- I. Considerations of tumors in general
 - A. General
 - B. Scientific
- II. Benign bone tumors
 - A. Reticulo-endothelial and lipoid types
 - B. Fibrous type
 - C. Osseous type
 - D. Giant cell tumors
 - E. Miscellaneous benign lesions
 - F. Malignant degeneration
- III. Malignant tumors
 - A. Primary bone lesions
 - B. Myeloma
 - C. Metastatic malignancies

Seventy-four articles are abstracted for this chapter, and they represent an extensive coverage of the many facets of the tumor problem.

Considerations of Tumors in General

General discussions of tumors include a review by MEYERDING et al (1) of many articles on tumors of bone and synovial membranes published for "Progress of Orthopedic Surgery for 1945".

In the surgical consideration of intraspinal tumors, ADSON (2) emphasizes early diagnosis since about 80% of intraspinal lesions are removable. Recovery can often be expected if operation is carried out before irreparable cord damage has been done. Tumors of the meninges, nerve roots, blood vessels, and supporting tissues outnumber those originating within the spinal cord by a ratio of four to one. A review of intraspinal tumors at the Mayo Clinic shows 29% to be neurofibromas, 25% meningiomas, 8.5% hemangioendotheliomas, 6% ependymomas, 10% sarcomas, 4% chordomas, and 11.5% intramedullary lesions. Chordomas are primary malignant tumors, but due to slow growth and accompanying pain, surgery is frequently justified. In such instances, radical removal should be attempted followed by roentgen therapy. Bone lesions producing cord pressure are discussed briefly.

An analysis of the twenty-two primary neoplasms of the cranial bones (1.4%) of 1518 primary neoplasms of bone seen at Memorial Hospital in New York from 1926 to 1948 is presented by VANDENBERG and COLEY (3). They state that fifteen were benign and seven were malignant. The authors admit that, due to their recording system requirements, the incidence of benign tumors is probably too low. Giant cell tumor is rare; it may be treated by roentgen therapy. Sarcoma has an extremely unfavorable outlook because, owing to its location, it does not lend itself to radical surgery. Myeloma of the skull is usually a manifestation of widespread disease. In the so-called "solitary" lesions, however, roentgen therapy may be of value.

Numerous articles of scientific interest are contributed which deal with the various aspects of tumors in general. The diagnosis of bone tumors is discussed by BRAILSFORD (4). The clinical findings must be taken into consideration along with x-ray changes. The lag in development and persistence of x-ray changes sometimes do not correspond to the physical condition of the patient. Biopsy is condemned. (Ed: The author stresses perhaps a little too much the dangers of biopsy and the inconclusiveness of the pathologist. It is to be remembered that anyone dealing with bone tumors should be thoroughly familiar with the clinical findings, x-ray manifestations, and gross and microscopic appearances of bone lesions. If considered alone, x-ray, clinical, and pathological interpretations can all be faulty, and a conclusion should not be based on the evidence of any one entity to the exclusion of the others.)

In a study of transplantable tumors, CRAIGIE (5) shows that serial passage of tumor is possible only in the species and genetic constitution in which it arises. A quantitative study as to amount, preparation, and manner of transfer is necessary in order to help elucidate the relation of virus to cancer.

To crystallize their findings in a lengthy study of the production of malignancy in vitro, EARLE et al (6) present a chart which correlates more closely the chronological relationships of the various studies presented and the relationship of the various cell strains and subordinate lines studies. This series of investigations has been in progress for more than eight years. There are no data from these studies that warrant considering the changes in the presumably untreated D control strain as essentially different, except in degree, from those shown by the cell strains deliberately treated with carcinogen.

KOLETSKY et al (7) report the production of malignant tumors in rats with radioactive phosphorus. He reports the development of thirteen tumors following injection with radioactive phosphorus, of which ten were osteogenic sarcomas. Atypical bone proliferation is seen in those developing malignancy. The incidence of malignancy in rats injected is given as 40%.

GROLLMAN (8), WALTON (9), GILES (10) and CARO (11) review the use of radioactive drugs and radiation therapy for malignancy.

LAYTON (12) discusses the efficacy of labeled inorganic sulfate in the diagnosis of cartilaginous tumors and their metastases. He relates that

muscle and tumor tissue taken from six patients with diagnoses of osteocartilaginous tumors were incubated in a sodium sulfate solution labeled with radioactive sulfur. The sulfur, he states, was then precipitated out with barium chloride and the radioactivity was measured to determine uptake. The author reports that cartilage takes up a large amount, while other types of tissue absorb much less, thus supporting the pathologic diagnosis of cartilage-forming tumor.

Experiments on virus interference by serially passed Hodgkin's disease extracts in chicken eggs are described by BOSTICK (13). A virus etiology has long been suspected in Hodgkin's disease, and this study shows that the amniotic fluid taken from a series of fertile chicken eggs inoculated with Hodgkin's disease tissue extracts reveals virus interference capacities and, thus, a difference from other tissue extracts. This factor is reported to have been encountered in all Hodgkin's disease extracts, and it is suggested that there may be some etiologic significance.

GOLDIE and HAHN (14) write that studies on mice indicate that immediate morphological changes and sometimes disappearance of free sarcoma tumor cells occur when the peritoneal fluid is treated with radioactive iodine. A control series does not show this change.

Data on osteosarcoma induced by beryllium oxide are compiled by DUTRA and LARGENT (15). After one year, eight of nine adult rabbits injected intravenously show evidence of osteosarcoma (six primary, two multiple). Results are proven by microscopic section. There is no evidence that beryllium causes tumor other than by intravenous administration to rabbits.

Benign Tumors

The reticulo-endothelial and lipoid types of tumors are considered by twelve authors. NIXON and PERRY (16) describe a case of reticulo-endothelial hyperplasia of bone.

STEVENSON (17) discusses xanthoma and giant cell tumor of the hand. Giant cell tumor is a firm, fixed, benign, nodular tumor arising from firm skeletal tissue. It is usually solitary and occurs on extremities. Recurrence is commonly due to incomplete excision. He feels that xanthoma is a manifestation of metabolic fault and is usually multiple and symmetrical. Microscopically they resemble each other.

Pseudocystic disease of bone is suggested by JACOBSON (18) as a term to include eosinophilic granuloma, lipid granulomatosis, and fibrous dysplasia. The interrelationship of these three lesions is discussed. Four cases are reported to demonstrate the similarity.

Histiocytic granuloma of the skull, a tri-phasic clinicopathologic syndrome previously termed Letterer-Siwe's disease, Hand-Schuller-Christian's disease, and eosinophilic granuloma, is the subject of an article by GOODHILL (19). All three are probably different phases of the same disease. Eighteen cases are reported. The basic disease processes are dysplasia

and hyperplasia of the reticulo-endothelial system. The term "histiocytic granuloma" is proposed to include all three phases.

HANSEN (20) presents five cases to demonstrate the relationship of Hand-Schuller-Christian's disease, Letterer-Sive's disease, and eosinophilic granuloma of bone. He, like Goodhill, contends that these are all phases of the same disease. What determines the phase is unknown unless it is the age of the patient at onset. WENTHOLD and HADDERS (21) also discuss this subject.

According to BUCY AND OBEYHILL (22) intradural spinal granulomas are rare lesions and are usually associated with Pott's disease. However, any agent causing a granulomatous reaction can cause such an entity without extradural or bone involvement. A case is presented of a granuloma around the spinal cord in the region of T-7 of tuberculous nature which caused pressure symptoms and spinal fluid block. The patient continues to be well three years after laminectomy and removal of the granuloma.

JOHNSON (23) reviews literature on thirty-six cases of intramedullary lipoma of the spinal cord and reports one case. The diagnosis is made by neurological symptoms. COLLINS and HENDERSON (24) report another case in a forty-year-old male with recent complete paraplegia and a twenty-year history of transient paraplegia. X-ray shows only a kyphosis.

Most of the articles on fibrous types of tumors are concerned with fibrous dysplasia of bone. A complete study of seven cases of this disease and follow-up reports on six of these is given by PROFITT et al (25). No one type of clinical examination will differentiate this from bone cysts and giant cell tumors, but proper interpretation of clinical, laboratory, roentgenologic, operative, and pathologic findings will differentiate between this and other diseases of bone. In most instances of multiple bone involvement by fibrous dysplasia, the diagnosis can be made by x-ray and the calcium and phosphorus levels. Healing follows fracture, as in simple bone cysts. In long bones, healing with new bone formation follows curettage. In a rib lesion with pain, the intercostal nerve should be excised with the rib.

Fibrous dysplasia of bone includes monostotic and polyostotic lesions as well as Albright's syndrome according to RUSSELL and CHANDLER (26). Basic morphology includes replacement of cortical and cancellous bone and marrow with fibrous connective tissue containing varying amounts of imperfect cancellous bone. Etiology and pathogenesis are still obscure. Biopsy is often necessary to make a diagnosis. Treatment consists of treating fractures, correcting deformities, and excising painful lesions when possible.

VALLS et al (27) state that the term, "fibrous dysplasia" cannot be applied with certainty to solitary lesions. No relationship is established between fibrous dysplasia and neurofibromatosis. He feels that solitary lesions are more often the final cicatrical stages of processes (inflammatory, metabolic, and traumatic) rather than dysplastic stages.

PERRY and HADEN (28) report four cases of fibrous dysplasia of bone and opine that the disease is more common than is realized.

A case of polystotic fibrous dysplasia, Albright's disease, is reported by HACKETT and CHRISTOPHERSON (29) because of the unusually early manifestations of sexual precocity in a five-year-old girl whose menses started on her second day of life.

The total pathologic picture of neurofibromatosis (von Recklinghausen's disease of the nervous system) is analyzed by LICHTENSTEIN (30). The basic lesions in neurofibromatosis are foci of hyperplasia and neoplasia of supportive derivatives of the ectoderm, sometimes with involvement of vascular and parenchymatous elements. The term "neurofibromatosis" or von Recklinghausen's disease of the nervous system, is used to differentiate this entity from the other, unrelated von Recklinghausen's cystic disease of bone. This condition is characterized by pigmented areas of skin, nerve tumors, and fibrocystic bone disease. A working classification of this varied disease is given. In the classical form, cutaneous lesions and tumors in the central and peripheral nervous systems appear with or without bony lesions. A central form exists with no superficial evidence of the disease, and this type has associated acoustic neurinomas, meningiomas, optic nerve gliomas, and spongioblastomas. The abortive type includes isolated *cafe au lait* patches, pigmented dermofibromatosis, and hypertrophy of portions of the body. A defective germ plasm seems at fault in the disease since most cases are congenital and hereditary.

A review of neurofibromatosis is given by FAIRBANK (31). The nature of the pathological bone changes remain obscure. A neurogenic origin of the subperiosteal lesion is acceptable, but the author does not feel this to be the case with endosteal lesions. Neurofibromatous tissue may or may not be found at the site of pseudarthrosis.

A case of intraspinal neurofibroma is reported by BUCHAN (32) showing widening of pedicles and erosion of bodies of T-12 and L-1. Another case of spinal neurofibroma is reported by SCHENKEN (33).

There are several articles which deal with tumors of osseous types. Osteoid-osteoma and its etiologic, pathologic, and clinical factors are reviewed by CHANDLER and KAELL (34). Seven cases are presented, including one with vasoconstrictor changes (increased sweating and a local rise in temperature). These changes are probably due to stimulation of sympathetic fibers near the nidus. Pain in osteoid-osteoma may be referred. Laminagrams may be of value in localizing the lesion.

Three cases of osteoma of the skull are presented by MEREDITH (35) who reports successful surgical removal of the bony masses. Two varieties are illustrated in that two of the cases are of a diffuse nature involving the frontal bone, and the other is a discreet, well-defined, dense mass in the temporal bone. The latter presents a greater technical difficulty in removal. The exact nature or etiology is not given. Symptoms are due to pressure from the location of the tumor mass.

ROBINSON and SPENCER (36) give an account of a sixty-five-year-old woman with a cancellous osteoma (heterotopic ossification) in the right breast. They state that, following a radical mastectomy, pathological

examination revealed cancellous bone in the small, hard mass with haemopoietic elements and chronic mastitis.

Two cases of osteoclastoma associated with generalized bone disease are described by HILTON (37), one associated with osteitis deformans and the other with osteitis fibrosa cystica. It is reported that sections were typical of osteoclastoma and neither case responded to x-ray therapy.

Of benign chondro-osteoblastoma, COPELLO (38) says that this tumor usually appears in the diaphyses of individuals between the ages of fifteen and forty. It is more common in women. Secondary malignant changes are possible, and lesions are both multiple and single. The condition is radio-resistant; recommended treatment is conservative surgical removal. Diagnosis is important in order to avoid radical, unjustified amputation. The author apparently refers to Codman's tumor (benign chondroblastoma of the epiphyseal-line area).

CORNIL et al (39) report four cases of osseous tumors developing in Paget's disease. They report that none died of metastases. In two cases, the tumors are classified as benign "histiocytomas"; in the third case, as multiple tumors, one being benign and another a malignant reticulosarcoma; and the fourth case, as a malignant reticulosarcoma. The authors theorize on pathogenesis, feeling that both the basic disease process and the tumor development are end products of abnormal activity in the "reticulo-histiocytic elements".

The report of a case of Hodgkin's disease with osseous lesions and slight lymph node involvement is offered by SUAREZ PUPO (40).

In 130 cases of giant cell tumors of bone diagnosed at Mayo Clinic from 1916 to 1947 by means of biopsy, MEYERDING and JACKSON (41) report that seven cases occurred in which the bones of the hands and feet were involved. One case is seen in the finger and six in the foot. These locations, the authors feel, are rare sites for tumors of this type. Microscopic confirmation is necessary for accurate diagnosis.

From one case of their own and a survey of the literature on nine others, FUCKLESS and LAWLESS (42) conclude that giant cell tumor of the ribs is a slow growing, benign tumor, but it may become malignant. Treatment of choice is surgical resection. Irradiation may be used, and the prognosis is excellent.

LEVINTHAL and KRAFT (43) review current opinion of radiologists and surgeons concerning proper treatment of benign giant cell tumor. No unanimity of opinion is seen as to the superiority of surgery, irradiation, or a combination of the two. The authors report ten cases treated by curettage, aspiration, and primary excision or resection, followed by immediate reconstructive surgery. They feel that this technique has the following advantages: (a) more definite and time-saving end results and (b) immediate cessation of the destructive process, diminishing the extent of necessary reconstruction in direct proportion to the time elapsing since onset. No definite statements concerning follow-up on these ten cases of

benign lytic bone tumors are given.

A case of giant cell tumor confined to the greater trochanter is reported by STEWART and JAMES (44) which was thought preoperatively to be tuberculosis. No others are reported in the literature.

HOWELLS and FRIEDMAN (45) find giant cell granuloma associated with lesions resembling polyarteritis nodosa.

Among miscellaneous benign lesions, unicameral bone cyst is frequently seen. One case is reported by HUTTER (46) because it extended across the epiphyseal plate into the epiphysis through a 2 cm. defect in the plate and did not involve the edge of the plate. The author states that curettage and filling with bone chips did not result in growth arrest.

Gaucher's disease in bone is well-discussed by KULOWSKI (47). He states that osseous manifestations occur "not infrequently", and they add an important diagnostic criterion to the better known clinical signs and symptoms of this disease. Bone lesions may be considered as primary and secondary. The primary lesion is due to the actual infiltration of the bone marrow by Gaucher's cells. This results in osteolytic areas in the roentgenogram. The secondary changes develop in the opposite direction toward bone condensation, and they are due to aseptic necrosis upon which is superimposed the effects of mechanical stresses and weight bearing. Some of the primary bone lesions apparently heal. One case report is given.

Two cases of endometrial tumors in the extremities are reported by DUNCAN and PITNEY (48) in the femoral area of the upper thigh.

Thirty-five children with acute leukemia treated with aminopterin are presented by KARPINSKI and MARTIN (49). These cases demonstrate the changes in bony evidence of the disease. New lesions may develop during therapy, while others disappear. Heavy transverse bands at the end of long bones are seen to develop during therapy. No specific action on skeletal lesions by aminopterin in acute leukemia can be stated from the authors' observations.

Malignant degeneration of benign giant cell tumor of bone is the subject of an article by LEUCUTIA and COOK (50). They report seventy-five cases treated at Harper Hospital, Detroit, from 1923 to 1947. Malignant degeneration is observed in 9% (seven cases). In four of these, it is seen to occur after routine roentgen therapy; in one, before the series of treatment was completed; in another, following roentgen therapy of such small dosage that its significance can almost certainly be disregarded (authors' statement); and in one case, "spontaneously". In this last case mentioned, the diagnosis is reported to have been made after unsuccessful roentgen therapy, histiological examination first being possible after amputation since biopsies were refused previously. In two cases of the total seven, degeneration following surgical procedures is shown. However, one of these, treated by three surgical interventions followed by roentgen therapy, is seen to develop osteogenic sarcoma seven years later.

In the other, degeneration is reported after curettage and filling with bone chips. The authors conclude that malignant degeneration occurs in 10% to 15% of cases as a natural sequence of events and is unaffected by the type of treatment.

HERRMANN (51) reports four cases of sarcomatous transformation in patients with clinical and microscopic evidence of multiple neurofibromatosis. (von Recklinghausen's disease). Three are said to have developed sarcomata in their sciatic nerves, and one, a sarcoma retroperitoneally. Patients should be cautioned about the hereditary possibility of transmission of the disease and associated congenital abnormalities. Diagnosis is simple clinically. Biopsy of cafe au lait spots or the neurofibromata should not be done because of the possibility of stimulating sarcomatous transformation. The lesions should be widely excised only if there is sudden swelling associated with pain, and then the operator should be prepared to do more radical surgery if the lesion proves to be a sarcoma. Such change is especially apt to occur during puberty or pregnancy. Radical surgery is superior to irradiation or nitrogen mustard as treatment. There is wide variation in the sarcomata histologically, even in different sections of one tumor.

COOPER (52) reports two cases of chondrosarcomatous degeneration of a myositis ossificans and urges early biopsy if diagnosis is in doubt.

Malignant Tumors

Primary bone lesions are of particular interest and importance to the orthopedist. An analysis of 205 cases of malignant bone tumors seen at Campbell Clinic since it opened is reported by PREVO (53). Of all orthopedic patients seen, 0.8% have tumors, and more malignant than benign cases are recorded (415 malignant, 287 benign). Analysis of the malignant ones admitted (205) reveals that: (a) five-year survival in Ewing's sarcoma does not assure freedom from metastasis and (b) in other bone malignancies, favorable results after five years are much more indicative of permanent cure. The most logical treatment is early amputation followed by irradiation.

A classification of the primary types of malignant tumors of the mandible is presented by CONLEY and PACK (54). The various types are classified with respect to size, position, and extension. Four basic surgical techniques, with individual modifications are described for the treatment. Six illustrative cases are reported to clarify the analysis and surgical approaches.

Fifty-nine cases of osteogenic sarcoma with survival for five years or more are analyzed by COLEY and HARROLD (55). Their series includes fibrosarcomas and chondrosarcomas. The prognosis is better in these than in the narrowly-defined, osteogenic sarcoma. The microscopic picture is the most reliable index as to prognosis. The greatest number of five-year survivals are amputees, with or without supplementary treatment (Coley's toxins, irradiation, etc.). The authors have abandoned the use of Coley's

toxins and preoperative irradiation. No five-year survivals in any malignant tumor of the proximal femur are reported. Five years is not a long enough period on which to base end results. Lobectomy is recommended for solitary pulmonary metastases in cases of low grade malignancy. The authors want to dispel the apathetic attitude that this disease is uniformly fatal and therapy of such little value that no great effort should be made to reach an early diagnosis and institute prompt treatment.

Vertebral location for Ewing's tumor, state CARTER and COVPTON (56), is noted to be 4.7%. A case is presented of the third dorsal vertebra with spinal cord involvement and symptoms. They state that the patient died two years after biopsy and palliative x-ray therapy.

Thirty-eight cases of fibrosarcoma of the extremities arereviewed by ZARZECKI (57) who is of the opinion that these lesions should be excised early and followed carefully. If there is recurrence, proven by biopsy, amputation should be done. This series of cases is reported to support this plan of treatment.

Extension of primary neoplasms of bone to bone marrow is studied by UPSHAW et al (58) on amputation specimens including fifty cases of osteogenic sarcoma, twenty cases of Ewing's sarcoma, and five cases of primary chondrosarcoma. Gross and microscopic studies at the Mayo Clinic are presented. Direct extension is the usual method of spread into the bone marrow from its initial location in a long bone. This may occur without x-ray evidence of its presence. Medullary involvement may extend a considerable distance past any gross evidence of such extension. Of these three tumors, Ewing's shows the greatest tendency to spread, osteogenic sarcoma the next, and primary chondrosarcoma the least. None of the chondrosarcomas show spread of more than three inches beyond the cortical involvement by the lesion; 45% of the Ewing's sarcomas and 20% of the osteogenic sarcomas do show this degree of spread. The amount of medullary involvement is not prognostic in osteogenic sarcoma; in Ewing's tumor, however it is. If amputation is done through the bone containing the lesion, microscopic examination of the bone marrow at the level of amputation is mandatory to determine whether the amputation is proximal to the lesion. The authors' statistics indicate higher survival rate if the amputation is proximal to the bone containing the lesions than if it is through the involved bone.

Twenty-one cases of multiple myeloma from the Winnipeg General Hospital are reported by BROWNELL (59). Pain and weight loss are the most common complaints. Bence-Jones protein is present in approximately 14% (3 of eighteen cases studied). This proteinuria is believed transient in nature. The value of sternal marrow aspiration for diagnosis is stressed. BLUEFELD et al (60) report one case of this malady with emphasis upon the fact that this is a generalized disease. RUSSO and BENDE^o (61) report seventeen cases of multiple myeloma and point out that it is a malignant systemic disease with a grave prognosis. Their findings are consistent with other literature on the subject. A case of multiple myeloma in a man aged ninety-two is reported by PARNES and WILSON (62).

In a case of multiple myeloma with new bone formation, KRAININ et al (63) state that the diagnosis was made on the basis of x-ray findings, sternal puncture, and the presence of plasma cells in the circulating blood smear. X-rays showed radiating spicules of bone in along bone, and biopsy revealed newly formed bone trabeculae. A slightly elevated alkaline phosphatase and a calcium of 15 mg% were found. The authors state that no autopsy was done.

A case of solitary myeloma of the sacrum is presented by NASSIM and CRAWFORD (64) in which the patient lived five years after the first detection by roentgenogram. Biopsy, and later autopsy, failed to show any other area of involvement. Proteinuria and a disturbed serum calcium balance are shown. A urinary output of calcium of 18% of the intake is recorded, and the ratio of urinary calcium to fecal calcium is 0.84:1 as compared to a normal of 0.22:1. On two occasions traces of Bence-Jones protein are recorded. A review of the literature on solitary myeloma is given.

Metastatic malignancies are described in several papers. A case of malignant melanoma metastatic to the femoral region with fatal outcome following simple excision, presented at a tumor clinic conference, is recorded in the CANCER BULLETIN OF TEXAS (65).

One thousand consecutive autopsied cases of epithelial carcinoma are analyzed by ABRAMS et al (66). The 272 cases showing bone involvement are broken down according to the primary sites as follows: 122 of 167 breast (73%), 75 of 160 lung (47%), 8 of 34 kidney (24%), 11 of 87 rectum (13%), 4 of 32 pancreas (13%), 13 of 119 stomach (11%), 11 of 118 colon (9%), 6 of 64 ovary (9%).

PEARSON and FITZGERALD (67) review 140 cases of carcinoid tumors with sixteen metastatic cases, two being vertebral metastases.

Thirty-five proven cases of thyroid cancer metastases in bone are studied from the standpoint of roentgen diagnosis by SHERMAN and IVKER (68). The salient features of this type of tumor are listed, and a basically uniform roentgen appearance is noted. Characteristically, this metastasis is purely osteolytic, resulting in a somewhat unusual feature of "bone destruction in continuity". This means that the metastatic destruction in a bone crosses a joint and extends into other bones. Incomplete, delicate septation, destruction in continuity, medullary origin, oval shape, indistinct borders, and absence of periosteal reaction are the commonest findings in this type of metastasis.

A second case of metastatic carcinoma of the femur treated by resection and bridging bone graft is described in ARCHIVES OF SURGERY (69).

IAVEDAN (70) presents three cases of complete fractures of the femoral neck without trauma in young persons following intensive irradiation of the pelvis for cancer of the uterus.

HIDDLESTONE (71) reports a case of a patient with a pathologic fracture of the femur secondary to metastasis from carcinoma of the breast. He states, that because of severe pain at the fracture site, treatment with intramuscular testosterone was instituted. Prompt relief of pain is reported, and roentgenograms are said to reveal the formation of dense callus at the previously osteoporotic fracture site.

LAFFERTY and PENDERGRASS (72) report two cases of testicular carcinoma with bone metastasis, one of which occurred in a male pseudohermaphrodite and was first discovered when metastatic lesions appeared in various bones. For this reason, the authors recommend that abdominal testes be removed if they cannot be brought into a position where they can be examined easily and frequently. The rarity of bone metastasis in carcinoma of the testicle is stressed, but the facts that pain from these metastatic lesions can be well controlled by irradiation and that these lesions can be sterilized by adequate dosage are brought out.

PHILLIPS (73) reports a case of new bone formation associated with direct extension into the pelvis from lymph node metastases in infiltrating carcinoma of the bladder.

Primary carcinoma of the nail, a rare tumor, is discussed by RUSSELL (74) who states that only eighteen proven cases have been reported. It is located along the sulcus of the nail, usually follows trauma, and has the gross appearance of carcinoma. It spreads locally and metastasizes late and regionally. Treatment is amputation.

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CHAPTER XI

CONDITIONS INVOLVING THE THORAX AND DORSAL SPINE

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I. Scoliosis

- A. General aspects
- B. Treatment
 - 1. General
 - 2. Medical
 - 3. Surgical
- C. Case reports

II. Other conditions of dorsal vertebrae

- A. Ankylosing spondylitis
- B. Extra-lumbar disc herniae
- C. Scheuermann's disease
- D. Parasitic infections
- E. Miscellaneous conditions

III. Conditions of thoracic vertebrae

Of the thirty-five articles in this chapter, articles on scoliosis comprise the majority. Other conditions of the dorsal and thoracic vertebrae account for the remainder.

Scoliosis

The first group of references deals with general aspects which have a bearing on scoliosis. The mechanism of rotation is explained by ARKIN (1). He bases his conclusions on a study of fifty-four anteroposterior roentgenograms of the spine taken in eight living subjects. The mechanism of rotation and lateral deviation of the spine is discussed at length and illustrated with diagrams and classical x-rays. In adults, convex side rotation appears when the spine is in lateral deviation, whether in flexion, extension, or neutral position; this tendency is strongest in flexion and weakest in hyperextension. In only one patient is there noted even slight concave side rotation, and this is produced when the patient is in a position of passive lateral deviation in extreme hyperextension. Concave side rotation, therefore, plays no part in clinical structural scoliosis. The intrinsic mechanism for rotation, in combination with lateral deviation, in the normal spine depends upon soft tissue tension rather than upon arrangement of the articular facets. The behavior in scoliosis can be summarized by stating that the structure under the greatest tension will describe the straighter line. (Ed: This is an excellent article and should be read by all people interested in spinal scoliosis.) BROCHER (2)

discusses this mechanism from clinical and x-ray observations and classifies scoliosis as being compensated or decompensated.

SKRYGIN (3) and VAN DEMARK (4) review the classification and treatment of scoliosis in children.

PONSETI and FRIEDMAN (5) give a well-documented and well-illustrated analysis of the prognosis in idiopathic scoliosis based on a study of 394 cases not treated surgically. Of these, 335 are observed through maturity. The cases are divided into five main patterns as follows: main lumbar, main thoraco-lumbar, combined thoracic and lumbar, main thoracic, and main cervical-thoracic. Transition forms are also seen between these primary classifications, but in most instances they can arbitrarily be classified into one group or another. As a whole, the main thoracic curve increases to greater deformities than the other patterns studied. The prognoses in the main lumbar, thoraco-lumbar, and cervical thoracic curves are usually favorable, while the prognosis in the combined thoraco-lumbar curve is usually good only if it develops after ten years of age and poor if it starts earlier than this age. In general, the prognosis is dependent in a great measure upon the age of the patient when the curvature develops. The most deforming curves originate at an early age, and, conversely, the curves detected when the maturity of the patient is well advanced increase only slightly or not at all. Of all the groups, the main thoracic curve usually appears at the earliest age. The idiopathic curves almost always increase during the growth of the skeleton, and they cease to progress about one year before the completion of the ossification excursion of the iliac apophyses. (Ed: This is an outstanding article on idiopathic scoliosis, and the attempts of these authors to analyze their findings and lend some degree of reliable prognosis is most noteworthy.)

Various methods of treatment for scoliosis are suggested. Surgical procedures are proposed by BELGRANO (6), FREDENHAGEN (7), LANCE (8), and FELIX (9). DE SEZE and LEVERNIEUX (10) describe the use of vertebral traction in the correction of scoliosis, and ISEWICH (11) cites the use of thoracoplasty.

KWALWASSER (12) reports a case of a patient with a severe right thoraco-left lumbar scoliosis, treated with electric shock therapy. He states that nine electric shock therapy treatments were administered to this patient preceded by 3 1/2 cc. of intocostrin and followed by 1 cc. of prostigmine 1000-2000. The psychiatric diagnosis was involutional psychosis melancholia, from which the patient had been suffering for eight months, and nothing was considered sufficient or helpful except electric shock therapy. Despite the severe deformities of her spine, this patient is reported to have had no difficulty following her treatments and no fractures as a result of the shock therapy.

Several illustrative case reports are given. ARKIN et al (13) report a patient having received large doses of x-ray therapy as a child in the treatments of multiple benign melanomata of the back and embryonal adenocarcinoma, Grade III. The scoliosis, in this case, conforms to the deformity which would be expected if the growth of the epiphyses on the left side of the lumbar bodies had been retarded. The authors state that the irradiation, which the patient received at the age of nineteen months, was directed to the left side. They point out that this is the only case of induced radiation scoliosis reported in the literature. (Ed: This report is most interesting.)

In an experimental study on radiation scoliosis, ARKIN and SIMON (14) report the results of their attempts to produce scoliosis in the spines of rabbits by the use of roentgen rays. A review of the past works in the production of this deformity by use of radium is given. The bone wedging producing this scoliosis is not the result of pressure from structural scarring in the concavity of the curve due to radiation, because the intervertebral discs are wider, indicating less pressure on the irradiated side. A single dose of 1000 R. is required to induce definite wedging in the spines of young rabbits, and this may be of clinical significance in the control of scoliosis.

ROEDERER (15) reports a case ofolisthetic scoliosis caused by aplasia of a sacral articulation.

A case of kyphoscoliosis complicated by paraplegia is described by PERUSI (16).

Other Conditions of Dorsal Vertebrae

Ankylosing spondylitis is selected for discussion by KNUTSSON (17), FORESTIER and CERTONCINY (18), LIESCH (19), GRUCA (20), and ZABOKRZYCKI (21). Most of the papers are devoted to case reports, but early x-ray diagnosis is stressed.

STUART and ROSE (22) describe the management of severe spinal deformity in a thirty-four-year-old patient by osteotomy between the first and second lumbar vertebrae, after La Chapelle (1946), with bone graft over the osteotomy site three months later. They report an uncomplicated post-operative course with no shock, ileus, or root pain, patient being allowed up six months after the first operation. Illustrations include patient before and after surgery as well as skeleton marked at osteotomy site.

Extra-lumbar disc hernias are described by DELACROIX (23) and LOVE and KIEFER (24). The latter outline the experiences in the Mayo Clinic in the treatment of seventeen cases of root pain and paraplegia due to protrusion of the thoracic intervertebral discs. This incident is reported twelve times in a period of ten years, from 1938 through 1948, giving an incidence of approximately two or three cases of protruded disc in the thoracic region per one thousand cases of ruptured discs in the entire spinal column. The rupture is seen one time at the fourth interspace, three times at the fifth, three times at the sixth, two times at the ninth, three times at the tenth, and five times at the eleventh. The symptoms and signs of these cases vary widely depending upon the size of the protrusion, its location in regard to the spinal column, and its situation in regard to the spinal cord. No clear-cut, true, recognizable, clinical entity exists. Diagnosis of a space-taking lesion, in the majority of cases, is established on myelographic examination of the spinal canal. Treatment of these cases consists of laminectomy, with removal of the protruded fibral cartilage, in fifteen instances and of decompression of the cord, without removal of the protruded disc, in two cases. The results of surgical treatment are outstanding in only those cases with root pain or cord compression, or both, without gross neurological defects. The patients with marked compression of the cord prior to operation usually have residual signs and symptoms indicative of irreversible damage to the cord itself. In order to obtain better results, earlier recognition is required, and treatment should be instituted before irreversible changes to the cord occur. (Ed: This excellent

article, by these experienced authors, should be read by everyone interested in rupture of the intervertebral disc of the spine.)

Scheuermann's disease, or necrosis of the epiphyses of the vertebrae, in adolescents is reviewed by FRANULOVIC (25) and by LANGIRON and LIEFOOGHE (26).

Parasitic infections of the vertebrae are cited by two authors. A case of echinococcosis of the vertebrae is reported by CAVINA (27) who reviews the differential diagnosis of disc hernia. BENASSI (28) discusses what he calls melitococcic spondylitis which appears to be echinococcus infection.

Miscellaneous conditions of dorsal vertebrae include a case of "clay shoveller's" fracture by muscular avulsion of the spinous process of the first dorsal vertebra, reported by VERDEJO and SANZ (29).

Other conditions which involve the vertebrae are discussed in case reports by SCHAFFER (30) on vertebra plana and by CHIARI (31) on multiple exostoses of the spinal column in acromegaly.

Conditions of the Thoracic Vertebrae

Early calcification of chondro-costal cartilage in spondylarthritis ankylopoietica is reported by ROTES QUEROL (32). JAROS (33) reports an isolated fracture of the first rib during gymnastics, and MULLER (34) reports a case of perforation of the heart by a fractured rib.

A case with the slipping rib syndrome is reported by TELFORD (35), and the anatomy, etiology, symptomatology, diagnosis, and treatment are discussed. Anatomically, the eighth, ninth, and tenth ribs do not communicate with the sternum, but each rib is attached to the one above by dense, fibrous mesh which surrounds an embryonal synovial membrane and its joints. Etiologically, this syndrome arises from direct or indirect trauma to the chest wall, whereby the protective capsule is torn, allowing the anterior end of a false rib to curl under the cartilage above and impinge on the intercostal nerve or its accompanying sympathetic. Symptomatically, pain, frequently dull and recurrent over a period of years, is a cardinal sign of a slipped rib. However, this pain may be sharp and lancinating, and, if occurring on the left side, it may simulate a heart attack. The pain is exacerbated by deep inspiration, exhalation, or sneezing, and, in some instances, by movement of the body or upper extremities. Ordinarily, the pain follows along the distribution of the intercostal nerve around the thorax to the back. However, by way of the sympathetic nerves and their connections to the epigastric, hypergastric, and cardiac plexuses, pain radiating from the thorax to the upper abdomen, the neck, breast, and inner aspect of the arms is not uncommon. Diagnostically, this syndrome can be ascertained if the abdominal muscles are relaxed and the hand of the examiner clutches the costal margin and manipulates it backwards and forwards while pressure is applied over the sternum with the other hand. The patient's symptoms are reproduced by this maneuver, and the hand of the examiner frequently detects this click or determines the hypermobility of the cartilage involved. The treatment of this condition is either medical or surgical, depending on the frequency and severity of the attacks. This article serves as a reminder of this rare condition which should be considered in patients having pain in the anterior chest wall, the abdomen, and even the neck, breast and inner aspect of the arms.

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CHAPTER XII

LOW BACK

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I. Low back conditions

- A. Anatomical
- B. General
- C. Conservative treatment
- D. Psychosomatic
- E. Surgical treatment
- F. Spondylolisthesis
- G. Miscellaneous

II. Ruptured disks and allied conditions

- A. Anatomical
- B. Roentgenology
- C. General discussion and etiology
- D. Diagnosis
- E. Treatment
- F. Results of treatment

III. Miscellaneous

There are 112 articles on conditions of the low back abstracted in this chapter. Articles dealing with the intervertebral disc syndrome are grouped together.

Low Back Conditions

There are seven articles abstracted on anatomical studies. TANZ (1) makes a report on x-ray studies of 57 subjects made to determine the normal range of motion at the 4th and 5th interspaces. The range of motion in both decreased with age; the 5th interspace loses its motion largely in youth; the 4th interspace loss is more uniform and gradual throughout life. About 25 per cent of the subjects over 40 (the majority of the group) showed no

evidence of lumbosacral motion by x-ray. At first a compensatory increase in motion of the interspace above was evident, but with age this motion also decreased.

Alignment of the posterior lumbosacral articulations is the subject of an article by GASKING and NICHOLSON (2). A normal anteroposterior view of the lumbar spine shows that the articular facets of the lumbar vertebrae lie in a sagittal plane, excepting those of L5-S1 where the joint spaces are normally not visible. If they are visible, either uni-laterally or bi-laterally, they are anomalous. This anomaly leaves this articulation subject to unusual stress and strain, and is called the "Putti Deformity." It can cause chronic back pain and sciatica.

In an x-ray study of the vertebral neural arch ossification in 40 children, ROWE and ROCHE (3) visualized a high incidence (60 per cent) of the neurocentral synchondrosis on routine oblique views. This normal finding disappears between the third and sixth years.

VLCEK (4), in a short article, describes the venous plexus around the lumbar vertebrae as demonstrated by x-rays and contrast media.

STURZENEGGER (5) states that 17-20 per cent of all lumbosacral spine x-rays show presence of spina bifida. The anomaly is rarely symptomatic in itself. The author quotes one case with chronic localized pain following a heavy direct blow, cured by removing the fractured fragments of the spina bifida arch.

SICARD (6) describes spina bifida occulta as a failure of closure of the neural arches from a disturbance of early embryonic development. This is said to occur once in five cases, or 20 per cent of all spines. In children with enuresis, 62 per cent showed spina bifida occulta by x-ray.

GIORGINI (7) discusses deep reflexes of the leg as aids in the diagnosis of neurological conditions. In addition to the more familiar tests, he lists a number of other reflexes which may be tested, making about 14 in all.

On chronic backache in general, KLEINBERG (8) makes a plea for better physical examination and proper diagnosis in compensation low back pain. Many cases are diagnosed as herniated nucleus pulposus and spondylolisthesis without findings to back them up. These are capitalized upon by claimants' attorney. The etiology and physical findings of the most frequent causes of low back pain are reviewed.

PHALEN (9) reviews the problem of low back pain from the viewpoint of the compensation factors involved. He asks for an awareness of the psychosomatic factors brought into play by accident cases with possible compensation.

BLACKSTONE (10) describes x-ray views necessary for low back studies.

In an article on degenerative lesions of the lumbar spine, BRIMFIELD (11) discusses spondylosis, spondylarthrosis, and degeneration of the intervertebral disk. He considers terms which imply an inflammatory process to be misnomers. Spondylosis is a degenerative lesion involving the vertebral

bodies; spondylarthrosis, on the other hand, is a degenerative lesion of the articular facets. Probable etiological factors and principles of management of these senescent conditions are outlined.

RAVAULT et al (12) review their 373 cases of sciatic pain and list the usual causes. They conclude that malformations of lumbosacral column may be the cause of sciatica in 23 per cent of the cases.

A description is given by HERSCHEL et al (13) of 12 cases of low back pain, together with a discussion of each case. In each a cause was proved, or an acceptable probable diagnosis was made.

A contribution to the diagnosis of athletic injuries is made by POTOTSCHNIG (14). He stresses particularly the difference between the origin of the injury, usually considered by the patient as quite unimportant, and the pattern of symptoms. Younger people often complain about sciatic symptoms which are refractive to treatment. The spine should be x-rayed in all such cases.

BAUMAN and RONNEN (15) give a general review of some aspects of this crux medicorum: the low back pain. They describe cases which they treated at the military hospital at Batavia.

In discussing conservative treatment, COSTE et al (16) review the various medical treatments of lumbo-sciatica; rest in bed and traction seem to be the most valuable, followed by the wearing of a good corset. They consider that complete relief can thus be obtained in a great number of cases. About one-fifth of severe sciaticas do not respond to the usual conservative procedures and must undergo surgical intervention.

KLEINBERG (17) describes sciatic scoliosis as a symptom complex arising from a disorder of the low back. The important problem is to identify and localize the lesion. The majority of patients with sciatic scoliosis can be relieved by conservative treatment. Stretching of the low back and sciatic nerve under anesthesia followed by application of a unilateral hip spica cast is recommended, with subsequent use of a brace, exercises, and physiotherapy.

SCHAUBEL (18) considers spinal manipulation a valuable means of treatment of acute or chronic backache where no organic cause can be found or where the cause is a herniated disc. Cases most amenable to manipulation therapy are those in which the pathology is presumed to be interference with interarticular joint movements by subluxation, the presence of adhesions, or of muscle spasm. The types of manipulations used are described.

SCOUGALL (19) and YOUNG (20) outline the accepted methods of conservative treatment. The latter warns that back pain in adolescence may be psychogenic.

STRONG (21) makes an attempt to classify cases of low back pain which fall into the category of fibrositis. Evidence is presented to show that this syndrome can be explained by a mechanism involving the sympathetic nervous system with its vasomotor effect, the localized muscle spasm with subsequent production of local and referred pain in a segmental distribution.

Whether the etiology be of a rheumatic, traumatic, or an infectious nature, a myalgic lesion develops from which the secondary phenomena originate. A reflex action is set up and all forms of therapy, whether they be medical, mechanical, manipulative, or chemical, tend to break up the reflex mechanism. Stress is placed on a more complete examination of the back. Guarded manipulations of the back and judicious use of procaine is recommended.

In a review of recent articles on the psychosomatic aspects of low back pain, PAUL (22) reports an incidence of a psychogenic basis averaging 10 per cent in the low back cases studied. This survey shows the need for more case studies of patients with low back disorders. The diagnosis of psychogenic back disorder is frequently missed.

PADOVANI and BACHET (23) present the results of study of 12 cases of backache in which no clinical or radiological evidence of an organic lesion could be found. These backaches involved principally the cervical and upper dorsal spine. In each case psychiatric investigation revealed a sexual disturbance. In all cases disappearance of the symptoms followed psychotherapy.

Traumatic neurosis, psychosis, and malingering are discussed as they relate to industrial head and back injuries by BARO (24). The importance of a complete initial examination, including a neurological examination and x-rays is emphasized. The author, however, does not recommend lumbar puncture or myelography in back injuries unless there is strong evidence for a herniated disc. When no significant pathology is found, the patient should be referred to a psychiatrist as soon as possible.

TUFO (25) expresses the opinion that increased muscle spasm following injury is often due to psychologic causes or to a conversion hysteria. He further states that this increased muscle tension is frequently an etiological factor in rheumatoid arthritis.

PADOVANI et al (26) discuss back pains which are an aspect of the depressive state which has been termed neurasthenia. The relation to sexual disturbances is very clear in this depressive sequence. It is in the form of a chronic and anxiety-producing lack of harmony between feelings and sexuality. A very large proportion of the patients (mainly female) had had a surgical operation in the lower abdomen or a gynecological treatment involving intravaginal manipulations. There is, he states, often a very clear relationship between these operations, sexual disturbances, and vertebral pains.

In discussing surgical treatment, RICARD and FRANCILLON (27) report seven cases where Wilson's type fusion using a metal plate affixed to the spinous processes of the involved vertebrae was used; six in the lumbar spine and one in the lower dorsal spine. The authors have a guarded acceptance of the procedure, but report good results.

A description of 12 cases in which Bosworth H-graft type of fusion was used is given by PICAUD and POUCEL (28). These cases included Pott's disease, vertebral fractures, spondylolisthesis, etc. The authors state the results were uniformly good. They mention that the patients tended to go into shock when the iliac graft was being taken, and recommend use of at least one liter of blood plus other fluids during surgery.

CHIGOT (29) reports on the use of a pneumatic balloon or bag under the iliac crests to control flexion and extension of the lumbar spine during spinal fusion, particularly of the Bosworth type, where it is desirable to produce more flexion of the spine when the graft is put in place. The use of an inflated bag during operation permits deflating to produce extension. This type of bag permits better abdominal respiration.

ENGH et al (30) present a technique for spine fusion using a large iliac bone block wedged between the spinous processes of L5 and the sacrum in the Bosworth manner. In addition the facets are denuded of cartilage and fixed with screws. Postoperatively the patient is kept in bed for three weeks. A cast is used only if the graft is unstable. Healing is considered complete in six months. 60 patients have been treated this way; 21 without screw fixation of the facets, and 39 with screw fixation. The authors do not cite specific results, but they feel that theirs were better with screw fixation.

According to PERROT (31) the fusion operation should be performed as a supplement to removal of a protruded intervertebral disk. He feels the operation of Bosworth using iliac bone has a double advantage of furnishing a rich source of spongy bone for incorporation in the graft, and of furnishing a secure fixation of the graft site.

Spondylolisthesis is discussed comprehensively by CAMPANARIO (32), who states that the defects of ossification in spondylolisthesis are primarily congenital, but the forward displacement of the body is due to superimposed trauma. He warns not to confuse spondylolisthesis with anomalies such as "brachispondylia" (hatchet shape vertebra) or "platyspondylia" (broad vertebra). It is necessary to differentiate actual fractures where the whole vertebra is displaced.

FERNANDEZ ROZAS (33) points out that the medico-legal aspect of spondylolisthesis in industrial accidents is very important. The difficult element lies, according to the author, in the estimation of the actual value of the symptoms, compared with the history and evidence of the injury. In all cases of accident, the physician should obtain the history so minutely that he can analyze the mechanics of the injury and roentgenograms should be made of every injured back. The author concludes that spondylolisthesis is primarily congenital, but usually the actual displacement is due to acute trauma, or indirect trauma of constant labor. In Argentina, as in other parts of the civilized world, an employer is liable for compensation when an employee appears with spondylolisthesis aggravated or accelerated by an accidental injury sustained in the course of employment.

MARIQUE (34) considers spondylolisthesis which accompanies fracture of articular processes. The x-ray pictures and clinical symptoms are very much like ordinary spondylolisthesis. The lumbar pains of these patients are out of proportion to the vertebral displacement and those coming to operation may have only a very slight displacement.

GIRAUD et al (35) report a case of spondylolysis of the neural arch of L5 with sciatica which has normal x-rays in anteroposterior and lateral views. The lesion was only disclosed by stereo-oblique views of LS joint. They recommend routine stereo-oblique views.

PRIESSNITZ's (36) description of spondylolisthesis of the 5th lumbar vertebra is given as a contribution to the etiology of lumbar pains in children. This condition is a rare finding in children probably because it rarely gives sufficient symptoms to warrant study. The occurrence of shifting of the vertebrae in children can be assumed only on the basis of a congenital fissure of the interarticularis portion. A case of symptomatic spondylolisthesis in an eight year old child is reported.

BUSTOS (37) feels that the posterior fusion operations of Albee and others for spondylolisthesis, etc., are not effective. He believes that the ideal method of fixation can be obtained by the Chaklin arthrodesis. Chaklin (1931) constructs an anterior buttress by removal of the intervertebral disc and adjacent bony surfaces of the bodies of the fifth lumbar vertebra and of the first sacral vertebra, and introduces in this space a transplant bone wedge. Chaklin performed the operation by an anterior abdominal extraperitoneal approach. The author suggests the Chaklin operation by an anterior transperitoneal approach as the ideal operative treatment for persistent low back pain or deformity from spondylolisthesis or scoliosis.

PERROY et al (38) report a case of sacrolisthesis; (retrospondylolisthesis)(Sicard); hierolisthesis (Lippens). Positive findings in x-ray were: (a) sacrolumbar subluxation forward, (b) reduction in the lumbar curvature, (c) narrowing of L5-S1 interspace. Displacement of the sacrum, they state, may result from congenital anomalies, postural defects, infection, disk disturbances, and severe or repeated minor traumas. Sacrolisthesis in women may be due to obstetrical conditions. The authors suggest orthopedic measures for treatment of the sacrolisthesis, and Albee fusion when the patient continues to have severe pain after nonoperative treatment.

Under miscellaneous, lumbar fat herniation is the subject of a paper by DAL LAGO and VERA (39). It has been shown that fat tumor in lumbosacral area may produce subjective symptoms identical with those of lumbago, and removal of these tumors relieves most of the symptoms, giving the best result.

DITTRICH (40) describes cases in which a diagnosis of lipoma in the region of the sacrum, or of herniation of fat through lumbar fascia was made, and claims cure of low back pain and sciatica by excision or by local nerve block or regional anesthesia, in high proportion of cases.

AUDIERR et al (41) report a case which resembled a herniated disc clinically, but which had a slow onset and had bilateral manifestations. At operation it proved to be a tumor within the cord at level of L3-L4 which partly eroded the bodies of these vertebrae. Histologically it was called a chordoma. Treatment by excision and postoperatively by radiation therapy was discussed.

Ruptured Disks and Allied Conditions

Anatomical and clinical studies on lumbar disc degeneration by FRI-BERG and HIRSCH (42) are based on observation of 100 cadavers in which x-rays of the spine were taken after it was dissected out. 15 cases were unstable and 17 cases had degeneration of the disc. Conclusions from the pathoanatomical studies were that disc degeneration gives clinical findings

when the annulus ruptures, that ruptures usually take place in the lower lumbar interspaces, that they occur posteriorly, and that the presence of a reduced interspace, sclerosis or osteophytes of the adjacent bone indicate a severely degenerated disc. Degeneration accompanies actual rupture of the disc. Clinical studies on 3672 cases who had degenerated discs, and who represented 38 per cent of the total number of patients treated for low back pain, showed that 57 per cent occurred in males, that manual laborers had no more than the general population, that 75 per cent of the degenerated discs occurred at L4 and L5. They also concluded that flexion-extension lateral x-rays of the lumbosacral spine were useful diagnostic adjuncts.

HADLEY (43) studied the effect of intervertebral foramen encroachment on the nerve roots using cadaver spines. The normal nerve roots or ganglion occupied only one-sixth to one-fourth of the opening with a surrounding reserve cushion space containing blood vessels, lymphatic fat and areolar tissue. They list the multiple factors that can produce foramen encroachment following disc degeneration. They urge careful exploration of the entire foramen in any operation to relieve nerve root pressure.

KUHLENDAL (44) and VOSSCHULTE and BORGER (45) independently present detailed and well written reports of anatomical and functional studies of lumbar disk hernia.

On autopsy specimens LINDBLOM and HULTQVIST (46) found fibroblastic proliferation and vascularization of the nucleus pulposus in 25 per cent of the discs studied. This was interpreted to be a result of trauma and a form of healing, but subsequent to absorption of the disc material. Clinically absorption of prolapsed portion of herniated disc does take place and symptoms may disappear. The reaction also leads to fibrosis in region of discs, longitudinal ligaments, dura, roots, ganglion and nerves.

SEZE and MERLE (47) conclude that twice as many patients with L5 sciatica stand with sciatic scoliosis as patients with S1 sciatica. The difference corresponds to the difference in physiology between the L4-L5 disk, which is very mobile laterally, and the L5-S1 disk, where the lateral mobility is usually very limited. The forward lateral flexion is very often adopted by the patient afflicted with L5 sciatica, since usually it brings about a lateral opening of the L4-L5 disk, which causes an effective decompression of the hernia. In many cases of S1 sciatica, due to the absence of lateral mobility, the patient cannot effect a lateral gaping and decompression of the hernia.

WILBERG (48) presents results of dissection of lumbar and sacral spines and confirms the existence of a nerve which arises distal to the ganglion, passes back through the intervertebral foramen into the spinal canal and there divides up. Nerve fibers were found in the ligamentous coverings of the disc. It was also shown that stimulation of surface of the disc at surgery caused pain but stimulation of the surface of the vertebrae or the ligamentum flavum did not.

Careful roentgenological technique, states KOVACS (49) can render unnecessary 80 per cent of the myelograms done in the examination of the discs, L1 to S1. The four most helpful points are (a) narrowing and wedging of the disc space, (b) osteophyte formation in the ligaments, (c) shift of the ver-

tebral body with stress, and (d) sciatic hook formation.

There are 253 myelograms reported by FORD and KEY (50). They were done for low back pain and 206 of these cases were operated upon. Myelographic diagnosis was accurate in 72.3 per cent of 206 cases. There were minor discrepancies in 8.3 per cent and major discrepancies in 19.4 per cent. The optimum quantity of Pantopaque for demonstration of pathology and avoidance of reaction was 3.3 cc. (one ampule). Of this series 27 patients with negative myelograms had positive operative findings.

For contrast radiography of the peridural space, ALBRECHT and DRESSLER (51) recommend the method of injection of the contrast material into the peridural space of the spinal canal in order to gain information about the vertebral bodies and intervertebral discs. Peridurography is tolerated better than myelography. Positive contrast medium seems preferable. The best results were obtained using a mixture of 20 cc. 35 per cent Perabrodil and 15 cc. 3.3 per cent Pantokain. The lumbosacral articulation is only very seldom demonstrable, nevertheless this method seems useful.

KRAMER (52) calls his method canalography, a roentgenologic examination after extra thecal injection of an aqueous solution of a radiopaque organic iodine compound into the epidural space by the sacral route. No detrimental effects were noted in patients thus examined. Some of the canalograms produced in the text show that it is possible to visualize irregularities in the shape of the vertebral canal. Little use has so far been made of the method for clinical examination, so the diagnostic reliability still has to be proved. The advantages of canalography, especially in comparison with myelography are considered. Since the radiopaque solution is totally absorbed by the venous plexus and is rapidly excreted by the kidneys, any form of myelography can still be done afterwards. The extrathecal injection of opaque media offers great promise as a diagnostic method in cases where anomalies of the lumbosacral vertebral column are accompanied by neurological disorders.

SEZE et al (53) mention the usual signs of radiological localization of herniated disc without use of intraspinal contrast media. To these signs they add two. One is demonstrated by static anteroposterior and lateral x-rays of LS spine. Here they describe a relative widening of the disc space on the side of the lesion at the level of the lesion, shown as a relative widening of the space posteriorly in the lateral view, and on the side of the herniation on the anteroposterior view. The second is seen in flexion-extension and lateral bending views in upright position (all views described are in upright position). In this test, lateral bending away from the side of the herniation shows uniform widening of the disc spaces on the side of the lesion, bending toward the lesion, the affected space stays open, the others narrow down.

LONGMORE (54), an x-ray technician, writes a short article pointing out that x-rays diverge from the tube to patient and that lateral films of the spine with the spine straight do not show the interspaces in their true aspect. He advocates curving the patient slightly to correspond with the arc of the diverging x-rays, to give a true projection of the intervertebral spaces, either using a string attached to the tube to line up the spinous processes equally distant from the tube or using a curved cardboard cutout

to line up the spinous processes in a similar manner.

Three cases are reported by ERNEST and HEILBURN (55) in which there were bizarre neurological findings suggestive of spinal cord disease associated with nerve root pressure. In all cases myelography was performed and in each the pattern of the defect showed a vascular component as the cause. The defects revealed themselves as pulsating, tortuous shadows of decreased density. All were confirmed by laminectomy.

HAUSSLER (56) writes that in most cases of lumbar disc prolapses with neurological findings requiring surgery, the level can be determined with sufficient accuracy clinically. If the prolapse is above L₄ or L₅ level air myelography is of help. A peridurography may help if the prolapse is large enough and the position is low enough. No x-ray contrast process, even myelography, can supply in every case definite positive or negative results.

BELZ (57), in an article which appears somewhat contradictory, suggests that the use of iodopin myelography should be abandoned because it is not wholly innocuous. Because there does not exist a really safe contrast medium, air myelography is preferred. Air myelography gives satisfactory visualization of tumors, but is less satisfactory for arachnitis. Therefore, the myelography with air is first employed when a process in the spinal space is involved. If localization is not clear the injection of iodine preparations may be employed later. For a disk prolapse air myelography is the best method for localization of the affected disk. The technique of air myelography is described.

Under general discussion and etiology, a large number of articles by authors of all nationalities were abstracted dealing with the subject of herniated discs in a comprehensive manner, including a discussion of the history, etiology, diagnosis, pathology and treatment. BRADFORD (58), KEY (59), NASH and PATTERSON (60), SIEHL (61), APPEL (62), CHAPMAN (63), JAEGER and LEHMANN-FACIUS (64), GRONEMEYER et al, (65), KROLL and REISS (66), and GUSTILO and WALKER (67) all wrote excellent articles of this nature.

BODMAN et al (68) present a short article by a physician about his symptoms and his difficulties with his own herniated nucleus pulposus.

SCHOLER (69) reviews the various etiological factors causing herniation of the intervertebral disc. He divides the factors into two groups: (a) degenerative causes for herniated nucleus pulposus, and (b) traumatic causes for herniated nucleus pulposus. He mentions the usual causes in each group.

ARNAUD (70) maintains that many lumbosacral joint conditions are capable of provoking a sciatic attack. Sciatica is indicative of nerve root compression. Edema or slipped disc may cause nerve root compression. Manipulation and orthopedic treatment should be tried before cases are considered resistant to medical treatment.

In Hungary disc pathology occurs most commonly in the hardworking class at a ratio of 4:1, as compared to clerical help, according to ZOLTAN (71). Conservative therapy is not the treatment of choice, since almost always a

complete cure occurs with surgery. Early surgical procedure eliminates the possibility of deformities of the lower back, which occur in the later stages. Complete cure in 89 per cent of the cases was found when treated early. Operation consisted of hemilaminectomy and curretting of the intervertebral disc without spinal fusion. Following operation, massage, exercise, and vitamin B therapy are given.

WOOD (72) discusses etiological factors producing disk injuries, the usual signs and symptoms, and the operative treatment. He concludes that the patient should be given considerable conservative treatment prior to surgery, myelography should be employed in every case, it is necessary to localize the level and to rule out tumors, and the disk surgery should not include low back stabilizing operations. He feels good results should be obtained in at least 80 per cent of the cases.

MANGINI (73) reviews the literature on sciatica and summarizes the current conception of the syndrome condition. He concludes that sciatic pain is usually due to intervertebral disk herniation and recommends operative measures for relief of sciatica. A discussor states that orthopedic examination of patients must follow the neurological examination and that nonoperative treatment will cure most cases of sciatica.

In the consideration of diagnosis, KEY (74) states that low back pain in children usually yields evidence of disease. The existence of herniation of the intervertebral disc in children is not generally recognized. The Mayo Clinic reports an incidence of 2.1 per cent over a three year period. The physical signs follow those of the adult with most recovering; 10 per cent going to surgery. The pathology usually reveals an intact annular ligament with a dome-like swelling, elastic consistency and filled with a semi-fluid grumous material. Conservative management consists of minimized activity (but continuing school), back support until asymptomatic, and postural exercises.

In a long and detailed article, DECKER and BUFFAT (75) report a meticulous study of chronic disorders of the vertebral column and call attention to the arthroses and to the intervertebral disk syndrome. Conclusions: Low back pain and sciatica may be due to conditions in the vertebral column (spondylitis, tumors in the vertebral column, traumatic causes, spondylolisthesis, etc.) or involving the pelvis or sacrum. Lumbago and sciatica are usually due to degenerative changes in the 4th and 5th lumbar vertebrae. The degenerative changes with hypertrophic arthritis occur with or without herniation of the disk. Low back pain is usually due to degenerative changes and sciatica is due to herniation of the disk. However, much "lumbago" is due to herniated disk, and a high incidence of sciatica is due to arthroses without protruded disk.

In his article, CRAMER (76) gives a list of even remote possible etiological factors and diseases which can cause sciatica. Since herniated nucleus pulposus is the commonest cause it must always be proved or excluded from the diagnosis. He discusses the disadvantages of the usual type of myelography. He feels that the low lumbar and upper sacral areas are not sufficiently visualized. He advocates sacral epidural injection of a contrast medium ("per Abrodil M", 35 per cent viscosity - Bayer) through the sacral cornu.

KEMP (77) describes a symptom of prolapse of the intervertebral disc, which proved to be highly significant. It consists of a pain radiating from the area of a disk prolapse on carrying out a hyperextension movement of the vertebral column, especially when the hyperextension is done together with lateral bending toward the "disease" side.

KUGELBERG and PETERSEN (78) emphasize the importance of noting weakness and atrophy of M. extensor hallucis brevis in L4 disks. This muscle is involved almost twice as frequently as other extensor muscles of the foot. Also in their series, only 16 per cent of L5-S1 disks exhibit any muscle weakness or atrophy, 90 per cent of L4-L5 disks showed muscle weakness or atrophy.

GAMA (79) reports two cases where neuralgic pain was wrongly ascribed to posterior hernia of intervertebral discs. He emphasizes that all proven herniations are not responsible for symptoms that sometimes coexist. The patients had typical pain, numbness and weakness but their symptoms were due to neuromas of the sciatica nerve.

130 consecutive cases of low back pain from the out-patient clinic of the University Clinics of Helsinki are reviewed by INBERG (80) to find the incidence of herniated lumbar disc. 23 or 18 per cent had proven herniations removed at surgery.

Treatment is discussed in 14 abstracts. ADAMS (81) reviews the classical symptoms of herniated nucleus pulposus and makes a plea for adequate conservative management prior to any surgical intervention.

YOUNG (82) suggests that epidural injection of hypertonic sodium chloride acts by reducing or abolishing edema of a nerve root by osmosis. Epidural injection of this solution is not likely to be of use if there are no symptoms or signs of nerve root involvement or if scoliosis, convex to the painful side, is present.

BLANCHE (83) gives a resume of the anatomy, pathologic physiology, history, findings, diagnosis, and therapy of ruptured intervertebral discs. The opinion is expressed that manipulative therapy has very little value and is dangerous. Surgical therapy should consist of the combined procedure of removal of the herniated disc followed by fusion of the affected segment.

MERCKELBACK (84) cannot accept an exclusive mechanical etiology in production of a herniated nucleus pulposus. He stresses the viewpoint of a frequent arthritic or rheumatic cause. He urges thorough and adequate conservative treatment before resort to surgery. He describes Bosworth's fusion as a desirable adjunct to herniated nucleus pulposus operation. The author indicates that the widespread appreciation of the diagnosis and surgical treatment of herniated nucleus pulposus in Germany is much more recent than in the United States.

A review of symptoms, diagnosis, and treatment of cases of ruptured intervertebral discs is presented by MUNSLOW and HINCEY (85). The authors conclude that 90 per cent of the cases are amenable to conservative therapy, but it is not likely to aid those patients with actual motor weakness due to nerve root compressions. Surgery may be expected to relieve those cases

that do not respond to conservative management.

MAYR (86) reviews the impact of accident insurance on treatment of cases in Austria. He mentions the relationship of acute injury from accidents as cause of recurrent and chronic conditions, especially in the low back. Acute attacks of back pain and/or sciatica can be brought on by a trivial but unfamiliar twist or lurch of the body, and not necessarily by heavy work. Most cases can be cured or improved without surgical intervention.

Because of the recent center of attention on surgical treatment of sciatica COSTE (87) points out that treatment was reasonable satisfactory before the etiology of the lesion was appreciated. He reviews the nonsurgical methods of treatment, including bed-rest with or without flexion position; traction, either on legs or pelvis; manipulation; x-ray therapy (not recommended); use of vitamin B-1; use of corset; and limitation of activity. About 20 per cent require surgery. He feels that many protruding herniated discs can spontaneously or by manipulation be reduced.

Four cases are reported by WYCIS (88) in which contralateral sciatic pain appeared after removal of a ruptured intervertebral disc. The occurrence was at the same interspace. Three of the cases were verified at operation, the patients being relieved postoperatively. A fifth case is presented in which ipsilateral symptoms were relieved by a contralateral removal of a partially herniated disc.

SCHELLER (89) discusses cases with disc symptoms which come to surgery, but in which no disc was found, yet relief of symptoms is obtained. Some believe an inflammatory neuritis may be the cause, or a thickening of the ligamentum flavum causing pressure on the nerve root, or an exostosis causing pressure or a narrowing of the L5-S1 neural foramen.

CREYSSEL (90) advocated arthrodesis of the intervertebral articulations following all surgical interventions for herniated discs. He concedes the value of bone grafts in traumatic conditions or in chronic backache of long duration without sciatica.

RICARD (91) discusses the pros and cons of arthrodesis of the intervertebral articulations as a sequel to operative intervention for herniated intervertebral disc. With removal of a herniated nucleus pulposus and subsequent disc degeneration, proper distribution of forces at the particular interspace is disturbed, resulting in repeated trauma of the opposing vertebral bodies. Lumbar sciatica occurs too frequently in these cases for one to be able to predict its ultimate absence or occurrence. Therefore, since arthrodesis is relatively simple, its use routinely is advocated in all herniated disc interventions.

HAAS (92) having previously shown that fusion of the vertebral bodies could be accomplished when the intervertebral disc was removed through the transabdominal approach, attempts to see if the same fusion could be accomplished through a posterior approach. The failure of complete union was due to the inability to remove sufficient disc tissue to expose bone on both vertebral bodies. This is more easily accomplished by the anterior or abdominal approach.

In an article on disc degeneration OLSEN (93) advocates spinal fusion after disc operation. His discussor agrees that there is a large group of patients which should have combined disc excision and fusion. He advocates consultation between orthopedist and neurosurgeon prior to operation to decide whether fusion should be done. He particularly advocates fusion where there is evidence of lumbosacral joint arthritis, or in patients that are to do heavy manual labor.

EATON (94) advocates surgical excision in proved cases which have not responded satisfactorily to conservative treatment. In those cases which present low-back manifestations of degenerative or traumatic pathology, internal fixation by fusion has been effective in controlling the symptoms of the disease.

Six authors discuss the results of treatment. HERBERT (95) optimistically states that in disk sciaticas of unquestionable origin, when the hernia has been found at operation and removed, the results are excellent. Although physical capacities may be somewhat limited, many who have been operated resume their former occupations.

SHINNERS and HAMBY (96) present a follow-up study on 355 surgically treated and 200 nonoperated herniated nucleus pulposus patients. 48.5 per cent of surgically treated patients stated they were cured; 29.5 per cent of the unoperated cases stated they were cured. Of compensation cases, 29 per cent of surgically treated were cured; 51 per cent of unoperated cases were not working. Overall picture: 91.5 per cent of surgically treated group were working, 86 per cent of unoperated group were working.

O'CONNELL (97) advises: "Reserve disk surgery to those presenting signs after conservative therapy has been tried and results will be excellent." In his series of 500 operative cases, 92 per cent were completely asymptomatic or greatly improved. Mortality rate was 0.4 per cent.

KRAYENBUHL (98) reports on his clinical study of 998 cases operated on for herniated nucleus pulposus. Early and late postoperative results in 459 of those operated are 40 per cent cured, 40-45 per cent improved enough to return to work, and 10-15 per cent poor results. Operative mortality was 0.3 per cent.

WAUGH et al (99) compare 70 cases treated surgically with 63 cases managed without operation. Generally the recurrent and more severe cases were operated on and better results were reported in these cases. At the end of 36 months, 69 per cent of operated cases could work full time, as compared to 53 per cent of conservatively managed group.

HEPBURN (100) presents postoperative results following herniated nucleus pulposus excision in 170 patients with over one year follow-up. 62 per cent of the patients reported persistent numbness or paresthesia. The author is not in favor of immediate fusion as routine treatment.

Miscellaneous

LEHRER (101) reports four cases of acute metastatic staphylococcal abscesses in the spinal epidural space. All of them were successfully treated

without leaving any ill effects.

Two proven cases of tuberculous spondylitis are reported by GIULIANI (102). The disease developed into a calcification of the nucleus pulposus. They can be found in purely degenerative processes as well as in inflammatory diseases. These two cases are significant because the presence of tuberculosis was proved.

The case of a 22 year old male who received a spinal anesthesia for a herniorraphy three years before is reported by WILSON (103). During the administration of the anesthesia he felt a sudden sharp pain in both legs. Subsequently he had recurrent back pain brought on by strenuous activity. After two and one-half years the pain began to radiate down one leg. Operation revealed a protruding disk impinging on the 5th lumbar nerve root. After excision of the disk the patient's sciatic pain was absent.

TOUHEY et al (104) report 48 cases of cauda equina tumor operated on over a 10 year period. 1056 cases of herniated nucleus pulposus were operated during the period. Cauda equina tumor was 4.3 per cent of total. The symptomatology of cauda equina tumor and intervertebral disc is similar. Necessity for early removal of tumor, if success is to be attained, is stressed. Most important diagnostic factor is myelography.

Seven cases of acute nontuberculous psoas abscess are reported by ZADEK (105). This disease is rare and frequently misdiagnosed. Treatment is early drainage through a McBurney incision. The chief findings are flexion and external rotation position of the hip, a tenderness with or without a mass in the pelvic fossa, and leukocytosis.

A case of echinococcus cyst of the psoas muscle proven at operation is reported by YBARZ (106). Spontaneous haematoma of the rectus abdominis muscle and a case is reported by MORRIN (107).

The sacroiliac joint is discussed by two authors. ABEL (108) reports that of a series of 160 traumatic paraplegics, 98 showed abnormalities of the sacroiliac joints radiographically, varying from paraarticular rarefaction and narrowing of the joint space to complete bony obliteration. One biopsy of a joint demonstrating moderately severe involvement showed atrophic bone with no evidence of a joint space or articular cartilage. The lesions described are quite similar in appearance to the sacroiliac findings in Marie-Strumpells spondylitis. It is conjectured that similar etiologic factors may be operated.

In two articles on chronic nontuberculous sacroiliac arthritis INGERMAN (109, 110) reviews the embryological development and the anatomical structures and relationships of the sacroiliac joints. Diagnosis is difficult. Subjective pain is not pathognomonic. Localizing signs are sought for in movements on the relaxed patient which move the sacroiliac joints directly or indirectly. The hypothesis of a relaxed articulation seems reasonable. Cases are classed as those due to major trauma, those from minor trauma secondary to postural imbalance, malformation, spondylitis, congenital lumbosacral malformations, those due to pregnancy and postpartum period, those due to sacroiliac osteochondritis (sacroiliac syndrome of adolescence of Rogers and Cleaves), those from infectious arthritis, and those from para-

sitic sacroiliac conditions. Treatment is first plaster immobilization, next sacroiliac arthrodesis, either intraarticular or extraarticular.

MALAGUZZI (111) observes that patients suffering from lumbar arthrosis show with some frequency some white narrow stripes elevated on the skin in the lumbar region; more rarely one can find the stripes in subjects which do not complain of lumbar pain. Such changes show a greater incidence in women than in men, particularly in the years of the menopause. The author points out that some constitutional and endocrine factors play a role in the pathogenesis of such changes. Reflexes of the vegetative nervous system caused by the pain in the deep tissues are important in the localization of such changes in the lumbar region.

CASIRAGHI and FARENGO (112) discuss lumbar hernia and describe the anatomy of Grynfelt's and Petit's triangles through which they occur. The etiology is believed to be congenital parietal dysplasia. The description and surgical treatment of a case are given.

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CHAPTER XIII

CONDITIONS INVOLVING THE HIP JOINT AND PELVIS

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- I. Hip pain
 - A. General
 - B. Diagnostic
 - C. Non-operative treatment
 - D. Palliative treatment
 - E. Surgical treatment
- II. Hip trauma
 - A. Dislocations
 - B. Fractures
- III. Reconstructive surgery
 - A. General
 - B. Resection and osteotomy
 - C. Arthrodesis
 - D. Arthroplasty
 - E. Other methods
- IV. Pelvis
 - A. Anatomical
 - B. Coccygodynia
 - C. Trauma

There are 73 articles abstracted in this chapter on conditions involving the hip joint and pelvis.

Hip Pain

Two articles deal with the consideration of hip pain in general. SAXL (1) considers the various insufficiencies of the hip in light of the various pathologic entities that may contribute. Stress is placed on the careful diagnosis of the various entities before treatment is to be started. SEZE and DURIEU (2) remark on the role of vascular factors in the pathogenesis of coxarthrosis. There are at least four conditions in which a single and pre-

cise cause, associated with important vascular lesions, can produce degenerative changes of the hip joint, e.g. caisson disease, reductions of congenital luxation of the hip joint, traumatic luxation of caput femoris and certain fractures of cervix femoris. These data along with certain clinical and experimental findings are suggestive of the important part played by vascular factors in the occurrence of a great number of hip joint involvements.

In the diagnosis of hip joint pain, MAURER (3) writes briefly on the diagnostic criteria by x-ray of Perthes disease and illustrates this in a case. KLOPPER (4) presents two cases of hip dislocation due to increasing interarticular pressure, one in a year and one-half old girl with inflammatory process and the other in a year old child with post traumatic exudation. FRANCON and PERLES (5,6) describe two tests for early diagnosis. With the patient on the back and hip and knee flexed (as Kernig's test), pressure on the knee causes pain. The second test is with the extremity extended and rolling from maximal internal to maximal external rotation. DARRIS (7) states that by radiography a minimal lesion with extensive pain indicates nothing to be done to the joint but denervation, injection, irradiation, and fergae. With extensive lesions it indicates : (a) posterior dislocation - requires stabilization, (b) ankylosis with deformity - requires osteotomy, (c) incomplete ankylosis with aseptic necrosis - requires resection with ankylosis or arthroplasty. FORESTIER (8) tabulates movements of the hip on which successive visit measurements are recorded for quick review.

Under the heading of non-operative treatment FRANCON (9,10,11) gives a rather complete generalized discussion of arthritis of the hip from 1834 to 1938. This included anatomy, pathology, radiology, etiology and pathogenesis in the first chapter. In the second chapter he discusses the early clinical manifestations as well as in the established and terminal cases. In chapter three he classifies the manifestations into various types in accordance with clinical findings, evolution, etiology and radiologic appearance. Chapter four deals with the criteria for diagnosis in light of the differential diagnosis and prognosis. Medico-legal aspects are covered. In chapter five he resumes the treatment and discusses the prevention and curative means (medical, physiotherapy, spas, orthopedic and surgical). He concludes that multiple means are available for treatment requiring a judicious choice in each individual so that a well planned regimen will bring patient relief as well as attenuating the disease.

FRANCILLON (12) describes the pathology of aseptic necrosis. He believes that non-weight bearing is essential and puts the patients to bed with traction, and later ambulates them without weight bearing. Treatment is prolonged several years if necessary.

NAGEL (13) reviews painful hips in adults from the etiology leading to the disability. Infection in childhood, Legge-Perthes, slipped capital epiphysis, trauma, congenital dysplasia, congenital dislocation, Otto pelvis, osteochondritis dissecans, osteochondromatosis, and other types of arthritis are discussed. The author emphasizes prophylaxis in early treatment and mentions fusion, cup arthroplasty and obturator nerve resection.

SAINT-MARC (14) suggests the division of treatment into two goals, relief of pain and improvement of motion and he employs the usual methods of obtaining such.

In the palliative treatment of hip pain, denervation is suggested by REYMOND (15) in those hips which are painful but maintain a good range of motion. He gives a review of the innervation of the hip joint with the technique of denervation. LIEBOIT et al (16) outline the results of 12 patients of advanced age who were operated upon for relief of pain in unilateral osteoarthritis of the hip by obturator neurectomy. The anatomy and approach by the inguinal extraperitoneal intrapelvic route are described. Follow-up maximum was ten months with relief in 11 of 12 cases.

A technique is described by HARMON (17) for the abdominal extraperitoneal section of the obturator nerve at the level of the anterior superior iliac spine. The muscle splitting approach allows a bloodless, non-shocking operation with early ambulation. NIEBAUER and KING (18) report 20 hips in 15 patients denervated for pain. A selective neurectomy was done in relation to the sensory area involved. Section of the nerve to the quadratus femoris consistently relieved pain of the posterior hip. Intraabdominal section of the obturator was most satisfactory in patients with adductor tightness. Extensive dissection for the femoral branches gave unsatisfactory results, and resection of the anterior hip capsule is recommended as easier technically and giving better results. COURTY and MARCHAL (19) present a technique for infiltration of the obturator nerve. The approaches are well explained and made understandable by five anatomic drawings.

RATHCKE (20) presents 14 hips relieved of pain by resection of the praesacral nerve. The results on follow-up in his series indicate a large percentage of relief. Operative risk is minimal. Duration of relief is somewhat limited. Bladder capacity is increased very little and it is believed that this surgery is indicated in those conditions in which bladder pain is otherwise incurable. PETR and BENES (21) describe antero-lateral chordotomy in cases of painful arthritis of the hip joint.

In surgical treatment of the hip Gibson (22) presents his posterior exposure of the hip joint, which is rapid, almost bloodless and which results in minimal detachment of the muscles. This approach may be used for most operations of the hip.

AUBIGNE (23) classifies cases into groups according to prognosis with treatment surgically. The prognosis may be good for post traumatic aseptic necrosis and congenital defects; medium for osteoarthritis and coxae seniles; and poor for progressive as rheumatoid arthritis or spondylitis. He divides surgery into minor operations - neurectomy, forage, capsulectomy and shelf operation - and major operations - arthrodesis and arthroplasty.

CHARRY (24) suggests early surgery not only for pain but also for mobility for once muscles are degenerated, rehabilitation is more difficult. He discusses treatment from a general standpoint and suggests arthroplasty over arthrodesis where possible with or without interposition, according to the case. With destruction of the head, he advises prosthesis.

The history of surgery for coxalgia since 1911 is reviewed by BLANKOFF (25). His is a somewhat confusing generalization (apparently referring to tuberculosis) which divides the treatment into four periods: early surgical intervention, operation only for abscess, arthrodesis and reconstructive. He feels that operation should be performed only when necessary, children

included, but not below 14 years of age, and that true coxalgia will not heal without ankylosis.

Hip Trauma

Hip trauma is divided into two main groups: dislocations and fractures. Excerpts from the orthopedic literature of the 16th and 17th centuries describing the reduction of hip dislocation are given by BROCKBANK and GRIFFITHS (26). In the first of a two-part article covering the literature, SHULMAN (27) discusses the types of dislocation, associated fractures, avascular necrosis and myositis ossificans.

CONSTANTINI and BUTORI (28) report a case of bilateral traumatic dislocation of one week duration in a 46 year old male, easily reduced by closed method using light anesthesia and curare.

THOMSEN (29) reports two cases of fracture and dislocation of the acetabulum. Case one had a primary open reduction with screw fixation and a four and one-half year follow-up showed satisfactory function. Case two was similar and was treated by traction with non-weight bearing. Six months later patient was seen with increasing pain and subluxation. A reconstruction was done replacing the upper acetabulum by iliac crest graft. Infection and nonunion followed and a similar state existed five and one-half years later. On the basis of these cases primary open reduction is stressed.

In fractures of the hip joint and pelvis, FRIDKIN and LAGUNOVA (30) discuss traumatic aseptic necrosis of the head of the femur.

Abduction, adduction and rotational fractures of the neck of the femur are discussed by HAUCK (31). The latter is emphasized as liable to not unite due to slight angulation. He points out that primary healing may occur and a stress fracture occur in the horizontal neck. The article is well illustrated.

HENRY (32) gives a general review of hip fractures and their management without statistics or cases.

Based on 98 cases of neck fractures treated by internal fixation with a nail, KURT (33) discusses nonunion. The author believes horizontal placement of the nail, producing great stress on all structures, contributed most often. No angle of less than 45° to the horizontal should be used. Reinsertion of the nail at a greater angle was sufficient to produce healing in several cases. The article is well illustrated and a curved nail is suggested in the discussion to remedy some of the problems.

Reconstruction Surgery

In general, there are four articles abstracted for reconstruction surgery. The operative procedures available for the arthritic hip joint and what each might accomplish is reviewed by STUCK (34). Emphasis is placed on pain as the dictating cause for all procedures, yet the specific operation varies with age, extent of destruction and the amount of disability to be produced.

MENEGAUX (35) discusses pseudarthrosis of the femoral neck, giving the

reason for pseudarthrosis, the examination of the patient with this condition, and the treatment which he divides into two groups: restoration and palliative. To the author resection-arthroplasty and the intertrochanteric osteotomy are the two procedures of choice, with arthrodesis and other reconstructions as the Colonna procedure as choices.

Experience in several newer methods of treating osteoarthritis of the hip is reviewed by HELFET (36). The intraarticular injection of lactic acid and procaine is useful if the joint space is somewhat preserved and the hip is mobile. Relief may be obtained up to two years. Denervation is unsatisfactory if incomplete, and the author has done no complete denervation. Arthrodesis by a one-stage method with bone graft across the joint and nail fixation is recommended with supple backs and where arthrodesis is the procedure of choice. Smith-Petersen mould arthroplasty has been disappointing in the hands of the author but no figures are given. Excision of the femoral head and neck has given good results for the author and is recommended in older individuals.

HALBSTEIN (37) gives a general talk on hip arthritis. No specific points are made.

Under the heading of resection and osteotomy, TAYLOR (38) discusses the technique of operation for pseudarthrosis, with excision of head and neck of the femur and trimming of the acetabular rim. In 93 cases reviewed, 83 were classed as good results, two cases developed spurs on the femoral stump, five others were unsuccessful for varying reasons. It is thought to be most effective in ankylosing spondylitis and in patients over 60 years of age with disabling arthritis since it is done to relieve pain and restore mobility with limited function.

OSBORNE and FAHRI (39) present a study of the mechanics of the hip joint to determine how much postosteotomy pain relief is due to diminished wear and tear on the articular surfaces. Experimentally with skeletal parts and weights it was determined that the pressure across the hip joint varied with position - adduction, midposition, abduction, and zero with the osteotomy (McMurray). The position of the distal fragment was displaced with the inner angle into the obturator externus and upper surface against the transverse ligament of the acetabulum and the lesser trochanter against the inferior ischial ramus. There were 75 cases with 93 operations reviewed. No clinically successful case showed radiographic progress of the arthritis and several showed improved joint surfaces. Cases without a block to adduction or adequate displacement radiologically improved on nonweight bearing but, those with weight bearing and continued pressure across the hip joint were unsatisfactory.

MILCH (40) describes an operative procedure for arthritis and ankylosis of the hip. The neck is divided at its base and the head and neck removed. The acetabulum is remodeled. The capsule is sutured over the neck stump. An osteotomy is done below the trochanter and fixed by a plate. The author presents one case and states he has employed it in ages 16-77 years and the patients are able to walk in six weeks. Patient follow-up is not given.

Following observation in the clinic of Milch, CHARRY (41) reports on

resection-angulation operation of the hip for arthritis. This consists of resection of the head and neck, capsular interposition, the introduction of a plate previously angled at 25° (Blount-Moore) into the greater trochanter, and an osteotomy at the base of the femoral diaphysis. Resection insures mobility and angulation with osteotomy stability, and the plate allows early ambulation with crutches at three weeks and weight bearing at six weeks. He advises the use of the operation in Marie-Strumpells in place of prosthesis or arthroplasty and also as a means of reconstruction following failure of a prosthesis.

Arthrodesis of the hip joint is the subject of eight articles abstracted in this chapter. STINCHFIELD and CAVALLARO (42) offer a follow-up study of arthrodesis of the hip joint, in which 117 patients were followed for four to 15 years after hip fusion. Nine over age 35 had only fair results, 19 patients with suppurative arthritis showed improvement after fusion. 69 patients with pain in the hip from osteoarthritis had relief with fusion. Overall pseudarthrosis was 23 per cent, mortality rate was 3.4 per cent, infection rate 6 per cent. Back pain was present in all groups in 31 per cent. The most normal gait obtained was with very slight adduction and no shortening, an acceptable gait in neutral abduction-adduction without shortening and the poorest gait was with abduction without shortening. Intraarticular fusion with a bone graft and a nail was most certain of fusion. Eight cases required osteotomy postfusion for unsatisfactory position.

SISKA (43) describes his modification of arthrodesis for the treatment of destructive coxitis. He removes the greater trochanter and the femoral head, raises a lamella of bone from the ilium which rests on the cut surface of the trochanter. He reports his experience with this operation in 10 cases.

KIRKALDY-WILLIS (44) presents a modification of the Brittain ischio-femoral fusion by approaching the region through an anterior Smith Petersen incision. Muscles, including the obturator externus, are divided or removed to explore the ischium. The graft is taken from the ilium and placed.

BOTEIHEIRO (45) discusses the physiology of the hip, especially regarding Brittain-type arthrodesis with case reports. WEIL (46) debates the virtues of the extraarticular ischio-femoral arthrodesis versus the iliofemoral method. He advocates the Trumble approach over the Brittain stating there is less danger of hemorrhage and nerve lesions.

CHAVES (47) reviews the ischiofemoral arthrodeses with mention of the techniques of Trumble, Moraglioni, Guitierrez, and Bosworth with emphasis on their success with the Brittain type. Six cases are presented, four of tuberculosis and two of dislocation.

Since 1942 DELITALA and PAIS (48) have treated 50 cases of congenital dislocation by open reduction and fusion. 45 cases were unilateral, four had subluxations on the opposite side, and one was a bilateral dislocation. The ages ranged from 12 to 40 with an average age of 18. The posterior-lateral approach between the tensor and gluteus medius was used with tenotomy of adductors if needed. In 23 cases, the trochanter was transplanted as graft, in seven no graft was used, and in 20 a trans-articular graft was used. 36 cases were followed from one to seven years with uniformly good results in absence of pain. One had failure of bony ankylosis with no pain. The

author indicates this procedure is to be applied in cases with unilateral high dislocation with good opposite hip and low back. He also emphasizes that the position of ankylosis must be exact, with a variation in abduction-adduction up to 10° in relation to the shortening.

FABIAN (49) discusses Tavernier's operation of arthrosis of the hip. He found that in every case, even during superficial anesthesia, there is considerable spasm of the adductors. This is the reason for the painful expression. He modified the Tavernier operation in such a manner that after the resection of the sensitive posterior branch he also partly resected the anterior branch (after Stoffel). This is extremely important because the anterior branch also contains sensitive fibers. He refrained from the Truchet operation which requires a second stage resection of the branch to the M. quadratus fem. n. carre crural. Access is from the trigonum Scarpaee with the electrical identification of the branches. He does not agree with total exhairesis because this causes disturbances in walking later. This operation is indicated in elderly patients with a simple disease process, where a major plastic operation is not necessary. These patients are satisfied if they can be assured of their walking ability for a few years. In 26 cases, all showed immediate considerable progress. Two patients who were unable to put their shoes on before operation were able to do knee-bends ten days after the operation. In four cases pain recurred a year after the operation but was not nearly so severe as before, and mobility was quite good. In the remaining cases the good results were maintained. The oldest case had a two year follow-up. Two cases were without benefit. The author is convinced from operations on 85 cases up to 1950 that dissatisfied cases were in consequence of not finding the n. obturatorius accessorius.

Arthroplasty is the subject of 11 articles abstracted. A comparison of the Smith-Petersen and Judet techniques is made by CHIGOT (50). He follows the usual principles and indications for his choice of procedure and cautions the use of the Judet approach when extensive acetabular surgery is indicated.

SALMON (51) presents two cases of congenital dislocation of the hip on whom arthroplasty was done one year before, by different techniques. Author advocates open reduction only when closed techniques are unsatisfactory and the arthrogram is positive.

AUBIGNE (52) reflects upon the indications for arthroplasty with inert interposition in arthritis deformans of the hip. He suggests vitallium mold for established cases with acetabular damage and synovial thickening. Otherwise no choice exists. In younger persons where a long neck exists the insertion of a cup maintains length which might be useful later in a fusion. In bilateral involvement, author suggests arthroplasty three weeks apart, unless bedridden for a long period, then fusion is necessary on one side. The author emphasizes the necessity of suitable selection of cases for musculature, lack of deformity and good technical surgery. A serious postoperative reeducation of the patient is necessary for satisfactory results.

KINI and NAIDU (53) report one case in which they did a vitallium mold arthroplasty which was followed for four months.

CHEYNEL (54) brings a preliminary report of a rather less expensive cup

which is of a special type and adapts itself more closely to the head of the femur. Author feels that from a recent report from a well known histologist the revascularization of the femoral neck with following regeneration in a patient of 50 years of age with no or little capsule, synovial membrane and round ligament, is quite an exception. He gives in detail the metals used.

JUDET and JUDET (55) give a description of the prosthesis and technique as employed by them for osteoarthritis, ununited fracture of the femoral neck, non-tuberculous ankylosis of the hip and old dislocation of the hip. No cases or follow-up are provided.

SICARD (56) reports a three week follow-up of a 64 year old woman with a Judet prosthesis in whom he did a lipiodol injection into the new articulation. He feels that this increases the postoperative analgesia and eases movements.

RICHARD (57) used a different technique in four cases of congenital dislocation of the hip treated with acrylic femoral head. The operative techniques which differ in each case are very briefly discussed and are not very evident.

AUBIGNE (58) presents 13 cases of high congenital dislocations treated in the adult with modern arthroplasty. He concluded that arthroplasty will bring the head down to its normal level when a new acetabulum has been made, will bring fair, though far from normal mobility, will increase the stability and decreases the limp and will alleviate and possibly eliminate pain. However, there should be a very cautious and careful preoperative examination before any surgery is indicated or undertaken.

JUDET (59) discusses a film on arthroplasty of the hip in congenital dislocation. He disagrees on the following points: the acetabulum should be made at its normal level, not at the level of the neo-acetabulum, the simplicity of the technique presented by Judet should not open the way to extensive hip surgery by the inexperienced surgeon, and finally, the sectioning of the femorocutaneous nerve in the Smith-Petersen approach. He emphasizes the need for great caution in deciding to use arthroplasty.

Arthroplasty of the hip with acrylic by SALMON et al (60) is a rather confused critique based on presented x-rays.

Among other methods of treatment in reconstruction surgery for hip joint pain is one of coxarthritis treated by capsulectomy reported by GUILLEMET (61). He states that degenerative changes in the joint itself may be a contraindication for capsulectomy, as the patient might not be relieved of pain by this procedure. Only 52 per cent of his 15 patients were more or less relieved following capsulectomy. In no case was the function improved and in some cases it was impaired. He concludes that capsulectomy will probably be only a step in more radical surgery for coxarthritis.

Pelvis

In studying the anatomy of the pelvis ROWE (63) examined 1539 specimens and three showed a similar anatomical variation consisting of loss of continuity between the superior articular process and the pedicle of the first sac-

ral segment. In two of these spina bifida involved the same neural arch and thus one-half the arch was free of any bony connection. The normal pattern of ossification of the neural arch is for one ossification center to appear in the cartilage between the superior and inferior articular process of each half of the neural arch and to spread from there posteriorly to meet in the spinous process and to meet anteriorly at the neurocentral synchondrosis. This anomaly could be explained by either division of the center or the appearance of two separate centers.

460 specimens were studied by SCHULTZ (64) to determine if secondary sex differences in the pelvis are limited to man. In all adult primates the ischium length is larger in males than females, but pubic length and pelvic inlet breadth are larger in the adult females than males. Measurements indicate there is no definite proportionality between the size of the pelvis and the size of the fetus.

Horizontal symphysis as a causative factor in abnormal deliveries is discussed by BRAULT and DUBOIS (65). DEMOULIN (66) reports a case of a male child born with absence of the abdominal wall and iliac bone on the right. DEUCHER (67) writes on the value of the sacral approach in surgery of the pelvis minor. He stresses the sacral or confirmed abdomino-sacral approach to the colon, rectum, sacral plexi or lower ureters. This is not orthopedic.

According to THIELE (68) coccygodynia is caused by direct trauma and by muscle spasm secondary to focal infection. It may be cured by massage of the spastic muscles, together with removal of foci of infection, when necessary or desirable. In rare cases of osteoporosis, osteomyelitis, or fracture surgical excision may be necessary.

HAGGART and SCHULER (69) and DESSE (70) review briefly the conservative methods of treatment, as manipulation, correction of posture, proper use of chairs, etc.

180 cases of rectal and low back pain were studied by SCHAPIRO (71) and are grouped according to their etiology and symptomatology. All groups showed tenderness or spasm of levator ani, coccygeus, and piriformis muscles on one or both sides. In group representing orthopedic conditions best treatment was obtained by orthopedic procedures. Manipulation of coccyx through rectum was effective in some cases. When no orthopedic condition existed, most were cured by rectal diathermy or massage. This treatment was effective for all groups. Digital examination of rectum was the most important diagnostic procedure.

In tumors of the pelvis, NELSON (72) describes a case of extramammary Paget's disease of ano-coccygeo-sacro-gluteii areas.

In trauma to the pelvis HORANYI (73) discusses dislocations in the pelvic girdle. He recognizes eight things that may happen: (a) lumbosacral spine from pelvis (spondylolisthesis), (b) unilateral luxation of pelvis, (c) bilateral luxation, (d) luxation of the ilium, (e) luxation of the sacrum, (f) luxation of the coccyx, (g) symphyseolysis.

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CHAPTER XIV

KNEE JOINT

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- I. Knee joint as a whole
 - A. Anatomical
 - B. Effusion and infection
 - C. New growths
 - D. Surgical treatment
 - E. Reconstruction surgery
- II. Menisci
 - A. Discoid menisci
 - B. Injuries
- III. Synovia
- IV. Ligaments
- V. Patella
 - A. General aspects
 - B. Dislocation and fracture
 - C. Chondromalacia
- VI. Quadriceps
- VII. Miscellaneous

The Knee Joint as a Whole

Of the 43 articles abstracted for this chapter, only four deal with the anatomical aspects of the knee joint. Articles on the anatomy of the knee include a 52 page monograph on prenatal development of the knee by GRAY and GARDNER (1). The knee joints were studied in a series of 45 human embryos and fetuses ranging in age from six weeks to term. The unchondrified blastema between the tibial and femoral cartilages becomes thinned to form a disc or interzone by seven and one-half weeks. This serves as a growth center for cartilage and in its middle portion, cavitation takes place. As the joint increases in size, and before a fibrous capsule is present, adjacent mesenchyme becomes intraarticular in position. The menisci and cruciate ligaments arise from the characteristically vascular synovial mesen-

chyme and appear first at about eight weeks of development. Vascularization of the cartilaginous epiphyses begins by 12 weeks, and ossification centers appear in them by term. The individual cavities enlarge, coalesce and form a single cavity by 14 weeks or soon thereafter. A fabella, first present in a specimen of 14 weeks, occurred inconstantly in the older specimens. The superficial prepatellar bursa appeared for the first time at 11 weeks.

PRICE (2) writes on the juvenile posture of the legs and knees. In the normal development of posture of the legs there is a varoid phase to the age of two years and a valgoid phase to six years. Abnormal varoid phases up to two years should be treated by Denis Browne splints. After two years osteoclasis is recommended. Knock knee of moderate degree responds to one-fourth inch medial wedge to heel only. Splints are not advocated until age of five, then the use of a Thomas knock knee brace is recommended. Very few children come to osteotomy for knock knee. Older patients may require it.

PEDERSEN (3) studied the ossicles of the semilunar cartilages of rodents and found them constantly present in the anterior portions of the menisci and frequently in the posterior portions as well. Reports on the ossification of the semilunar cartilages in man were reviewed and the reason for such ossification discussed. It is felt that a completely intrameniscal osseous in man may be a vestigial structure but that it is of normal occurrence in rodents.

GARDNER et al (4) determine that articular afferent fibers from knee joint synapse with internuncial neurons shortly after entering spinal cord and continue rostrally in ipsilateral dorsi funiculi to the medulla oblongata.

In effusion and infection of the knee joint BOUREL (5) gives a detailed listing of all known causes for swelling of the knee joint and the specific treatment when available. No new concepts were advanced.

Three papers are discussed by WEISSENBACH and FRANCON (6). They covered hydrarthrosis of gout which can show itself in three ways as the first sign of illness, alternating with sore inflamed great metatarsophalangeal joint and gout superimposed on hypertrophic arthritis caused by gout. The second paper discussed the various phases of rheumatoid arthritis of the knee. The third paper concerned postmenopausal arthritis in female and hypertrophic arthritis in male.

A series of abstracts are presented in REV. RHUMAT. (7) covering studies on hydrarthrosis of the knee. Causes given were: (a) gout, (b) degenerative osteoarthritis, (c) tumors, (d) arthropathies (luetic and syringomyelia), (e) hormonal origin (hyperfollicular stimulating hormone, thyroid dysfunction, eunuchism), (f) traumatic and microtraumatic (fractures, tears of menisci, tears of ligaments), (g) faulty weight bearing alignment of knees, (h) congenital syphilis, (i) lymphogranuloma inguinale, (j) rheumatic fever, (k) gonorrhreal arthritis, and (l) hypertrophic arthritis.

BLANKOFF (8) presents 19 cases of early tuberculosis of the knee diagnosed first by x-ray and later confirmed by laboratory studies including pathological slides. Earliest x-ray signs are marginal decalcification of

the condyles, plateaus, posterior part of internal tibial plateau and tibial crest. This decalcification bites toward the depth of the condyles. Author suggests that these early x-ray findings should influence a physician to treat these knees as tuberculosis.

A case of pseudomonas aeruginosa pyoarthritis of the knee treated successfully with streptomycin parentally and locally into the joint is reported by CARNSALE and WAISMAN (9).

In considering new growths in the knee joint a case of osteocartilaginous loose body is reported by BASTIEN (10). It was five and one-half centimeters in longest diameter and was removed by vertical sectioning of the patella with successful results.

SATANOWSKY (11) reports a case of giant cell granuloma of the knee. This tumor involved the fat pad ligaments, the infrapatella ligament and the lateral semilunar cartilage. Microscopically the tumor presented small spherical masses. These were bluish white, resembling cartilaginous tissue. Some areas had hemosiderin deposits with peripheral redness, and some had small hard vegetations. Microscopic picture was sclerosis of fat pad, old organized hematoma and lobulation with infolding of hyperplastic synovium. Tumor tissue consisted of young connective tissue cells with little protoplasm and big, well colored, nucleus and small nucleolus. Some hyalin degeneration was present. Authors feel this tumor is of a granulomatous rather than neoplastic origin.

SARPYENER and AKAD (12) report a case of synovial chondromatosis of the knee joint containing 2000 nodules treated by complete synovectomy.

Surgery has been recommended for many conditions of the knee joint. MARCONI (13) discusses the importance of arthrotomy of the knee for differential diagnostic purposes when the x-ray and other methods do not give the diagnosis.

KELIKAN (14) discusses the anatomy of the knee joint and the indications for surgery. Conditions listed are: drainage for pyogenic arthritis; fusion for tuberculosis, flail joint, Charcot joint, and advanced painful arthritis; cartilage injuries; synovial out-pouchings; osteochondritis dissecans; osteocartilaginous loose bodies; chondromalacia of patella; patella fractures; depressed plateau fractures; pigmented villonodular synovitis; subsynovial tumors; and Thompson stripping for quadriceps adhesions.

BEARZY (15) reviews internal derangements of the knee joint, with their diagnosis and treatment.

BUIRGE (16) makes statements on a study of 283 patients admitted to Oliver General Hospital, during an 11 month period in 1943. He stresses the importance of quadriceps exercises pre and postoperatively. The spring scale muscle test was advocated for determining quadriceps muscle power recovery following arthrotomy and knee joint injury. Author had no reliable method of determining location of tear of meniscus. He recommended excision of apparently normal medial meniscus, when no tear was found, to prevent missing a posterior tear.

In reconstruction surgery of the knee SKARENBOORG (17) presents the results of 45 cases of knee resections, including tuberculous and non-tuberculous types of infection. The indications, technique and results are presented.

The technique of nylon arthroplasty of the knee is described by KUHNS and POTTER (18). A median parapatella incision was used; condyles of femur were rounded off. A trough was made in the tibia and the menisci and the cruciate ligaments were excised. The patella was thinned and medial and lateral collaterals were saved. Nylon was sutured over all surfaces including suprapatella pouch. Postoperative care was discussed. Authors state that useful range of painless motion can be obtained in knees destroyed by chronic arthritis. Many of their patients had 90° motion.

COSTANTINI (19) advocates the use of a tibial autogenous bone graft in the intramedullary cavities of femur and tibia in arthrodesis of the knee to prevent displacement while awaiting fusion.

Arthrodesis of the knee with the use of a Kuntscher nail is described by CASTILLO ODENA (20).

Menisci

JEANNOPOULOS (21) reports a series of 21 discoid menisci removed from 18 patients in a 15 year period at New York Orthopedic Hospital. An unusual case of both menisci in one knee being discoid was presented. 42.8 per cent of these menisci showed either central mucoid degeneration or peripheral cysts. X-ray findings in some cases consisted of widening the lateral joint space and occasionally hypoplasia of lateral femoral condyle.

BURMAN and NEUSTADT (22) believe that high fibular head is a regressive anomaly resulting from a developmental failure to exclude it from the knee joint. The embryology of knee joint cartilages and proximal fibular head were discussed. Cases were presented which demonstrate: discoid meniscus without tear give disability; borderline cases in which the condition is between snapping and locking; and cases of locked knee because of tear of discoid cartilage. The roentgenologic signs of discoid meniscus are flattening of the external femoral condyle, widening of lateral joint space and high fibular head. The discoid meniscus and tear can sometimes be seen.

Injuries to the menisci are quite common. BONAR (23) reviews 200 meniscectomies and the various factors influencing the postoperative disability period. The greatest single factor is age. A delay of up to six months between injury and operation has no obvious influence on the disability time. The disability period is not significantly affected by the nature of the individual's work. The results of meniscectomy in a joint with severe osteoarthritis are very discouraging. Minor degrees of arthritic change are not a contraindication to operation.

HEMBROW et al (24) review the operative treatment of 140 servicemen with internal derangements of the knee.

SCARFI and GAMBIER (25,26) in two similar papers make a report on a series of cases treated by meniscectomy. 40.9 per cent resulted in arthritic changes, 74 per cent showed reduction on intra-articular space, 57.9 per cent

of cases had almost perfect functional results, 28.8 per cent of the cases were satisfactory and 11.1 per cent received doubtful beneficial results from surgery. Cases were followed seven to ten years minimum. Authors feel that total meniscectomy gave the best results.

Synovia

A report on 36 partial synovectomies for chronic polyarthritis and other cases with unknown exudate is presented by MAGNUSON (27). Final results are presented.

PIPKIN (28) discusses the fact that the suprapatellar space of the knee joint is developed embryologically from two structures. These are the suprapatellar bursa and the suprapatellar portion of the knee joint. A suprapatellar plica can be demonstrated by pneumoarthrography in 78 per cent of the adult knees studied. This plica represents a remnant of the mesodermal layer separating suprapatellar bursa and knee joint proper. In the majority of instances this plica has various sized defects permitting free communication between suprapatellar bursa and knee joint. A case of calcification of suprapatellar plica treated with surgical excision was presented. A second case of hyalinization of the suprapatellar plica which was treated by partial synovectomy was also presented. Fibrosis, hyalinization, or calcification of the suprapatellar plica mechanically interferes with the extensor apparatus producing a syndrome of pseudolocking, pain, and chronic effusion which must be differentiated from other intra-articular disabilities.

Ligaments

McCONVILLE (29) states that collateral ligament tears which do not respond to four weeks immobilization in plaster should be repaired: imbrication to tensor fascia lata used to repair lateral collateral ligament tears. Uninterrupted gracilis tendon graft was used to replace tear of medial collateral ligament. 16 cases were reported with stable knee joints resulting, ten lateral ligaments were repaired and six medial ligaments were repaired.

Patella

Two articles in this category were on the general aspects of the patella. CAVE and ROWE (30) recommend that chondromalacia of the patella be removed surgically when causing symptoms and findings of derangement. Patellaplasty should be done in hypertrophic arthritic patella. This consisted of using a saw to remove articular portion of patella and covering raw bony surface with flap from infrapatella fat pad. Torn cartilages and loose bodies should be removed. Authors condemn patellectomy as treatment of chondromalacia and hypertrophic arthritis. 18 cases were reported. Dr. Paul B. Magnuson of Chicago suggested complete joint debridement. Dr. Harry C. Blair of Portland felt that surgical excision of chondromalacia of patella was sufficient.

Indications for total or partial patellectomy enumerated by GUILLEMINET (31) are as follows: (a) closed fractures, (b) comminuted and transverse, (c) old fractures with fibrous callus and pathologic fractures of alcoholics and diabetics, (d) early compound fractures and occasional old compound fracture in face of infection, (e) osteomyelitis of patella, (f) early

tuberculosis of patella, (g) tumors of patella, (h) degenerative arthritis, (i) posttraumatic arthritis, (j) recurrent dislocations.

There are two articles on dislocation and fracture. COODE (32) presents a case of osteochondral fracture of the medial one-half of the articular surface of the patella successfully treated by patellectomy and removal of a fragment from the lateral side of the knee. Two previous cases were reported in the English literature. Injury is probably produced by a glancing blow striking the patella on the medial aspect.

PRUVOT (33) reports two cases of habitual dislocation of the patella.

SPRAY and GHORMLEY (34) report on 50 cases of chondromalacia of the patella, and the following points were brought out: age varies from 14-62 years, with an average of 39; sex nearly equal; trauma to patella in 54 per cent; incomplete locking present in 32 per cent; difficulty in climbing steps present in 24 per cent; knee joint effusion present in 56 per cent; suprapatella crepitation present in 74 per cent; patella tenderness present in 14 per cent; and marginal osteophytes of patella most common x-ray finding.

COSTE et al (35) discuss chondromalacia of the patella.

PROCHAZKA (36) differentiates osteochondritis of the patella into two types: prepubertal and pubertal.

WOLF (37) discusses the history and reviews previously recorded cases of Larsen-Johanssen disease; the possible etiology, pathology and clinical features, with a form of treatment suggested.

Quadriceps

SCUDERI and SCHREY (38) review 14 quadriceps tendon ruptures. Diagnostic criteria were discussed. Author advocates early recognition and prompt suture with Bunnell pullout wire sutures and with interrupted or chromic catgut sutures placed in x manner. Early suture precludes fibrotic contracture of quadriceps mechanism and gives much better range of motion. Late repairs require Codivilla lengthening of quadriceps mechanism before suture can be accomplished.

MICHOTTE (39) presents a case of bilateral rupture of suprapatellar tendons successfully repaired 11 months following trauma.

A case of rupture of the anterior rectus femoris tendon only with the rest of the quadriceps mechanism intact is presented by SARLIN (40). Injury was incurred by forceful extension of the quadriceps muscle. The tendon was sutured with nonabsorbable suture and functional recovery was excellent. Author comments on the small number of reported cases of partial tear of quadriceps as compared to the large number of total tears in the literature.

Miscellaneous

CAPECCHI (41) discusses the relation of the glenna constant to arthritis of the knee. The femoral neck should form a right angle with the longitudinal axis of calcaneus. Weak feet lead to a valgus deformity which in-

terfers with femoral-calcaneal angle. This results in abnormal rotation at knee to correct this altered angle. Treatment should be directed to correcting the femoral-calcaneal angle rather than treating knees locally.

LOHE (42) reports increased stability in flail knees produced by doing osteotomy of proximal end of tibia and tilting the tibial plateau backward.

MOFFATT (43) placed patients prone on a table flexing knee to 90° and rotating medially and laterally while exerting strong traction in flexion and extension to free impacted loose bodies in the joint.

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CHAPTER XV

CONDITIONS INVOLVING THE FOOT AND ANKLE

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I. Foot

- A. Disorders involving the toes
- B. Anatomic deformities
 - 1. Flat foot
 - 2. Others
- C. Preventive and therapeutic measures
- D. Footwear
- E. Methods of stabilization
- F. The factor of trauma
- G. Specific conditions

II. Ankle

- A. Traumatic conditions
- B. Preventive and therapeutic measures
- C. Specific conditions

The 67 articles selected for review in this chapter approach the problem of foot and ankle conditions from anatomic, etiologic, diagnostic, preventive, and therapeutic points of view.

Foot

Several articles are reviewed which concern various disorders involving the toes. JAROS (1) describes two cases of congenital hallux valgus. There are three types: (a) tri-phalangeal, (b) congenital type associated with supernumerary bone between the first and second metatarsal bones, and (c) familial. Only surgery corrects the deformity, operative procedures being osteotomy of the first phalanx or the first metatarsal or excision of the supernumerary bone.

LAKE (2) discusses surgical correction of hallux valgus. Operations mentioned are excision of the bursa and exostosis, Keller's operation, and the author's operation in which the insertion of the adductor and half of the flexor hallucis brevis are transferred to the neck of the metatarsal.

CLEVELAND and WINANT (3) give an end result study of the Keller operation for hallux valgus in 193 operations, 90 per cent of them in women.

The condition is probably due to incorrect foot wear. The authors state that 81 per cent of their cases are bilateral. They advise the use of the tourniquet at the time of the operation. It is advisable to remove the periosteum with the bone on resection of the proximal half of the proximal phalanx; otherwise, the bone may regenerate. One should also be sure to remove all bone chips and the rough edge of the bone. At least half of the phalanx should be removed. With this operation, a long convalescence is necessary, most of the cases reported remaining in the hospital 15 to 18 days. Since the healing of the wound is rather slow, sutures should not be removed for 12 to 14 days. It is advisable to split or remove the medial side of the shoe to prevent pressure, and these shoes should be worn for at least a month. Metatarsal pads, properly placed, give some relief from pain following surgery. He reports 12 per cent excellent results, 81 per cent good results, and 7 per cent poor results. His rating of excellent means a normal range of motion with complete correction of the valgus; good, a fair range of active motion, that is from 30° dorsiflexion to 10° plantar flexion, with less than 10° of valgus. The complication most frequently encountered is slow wound healing. He reports six infections, with some development of stiffness.

HARTWICH (4) discusses the results of various types of operative procedures for hallux valgus. He is of the opinion that the operative procedures which shorten the metatarsal or the proximal phalanx produce their main effect through shortening of the extensor hallucis longus tendon. He advocates the excision of the proximal phalanx with plication of the capsule to maintain abduction. He reports only 26 cases showing posttraumatic arthritic changes in 198 patients operated upon.

BINGOLD and COLLINS (5) state that hallux rigidus is a painful condition of the joints of the great toe associated with loss of dorsiflexion of the first phalanx. Early, it is pathologically suggestive of traumatic synovitis, and later it becomes an osteoarthritis. The radiographic picture of increased density and fragmentation is of no significance, as it is seen in normal feet. The cause of hallux rigidus is an abnormal gait developed to protect an injury or an inflamed joint or to stabilize a hypermobile first metatarsal. This abnormal gait causes an abnormal wear of the shoes, and the author feels that he can diagnose this condition by merely looking at the patient's shoes.

JAROS (6) suggests, in cases of hallux varus associated with polysyndactylism, the following procedure. A resection of the fibrocartilaginous perhallux should be made with conservation of the skin. Through the same skin incision, a transverse arthrotomy of the first metatarsal phalangeal joint is done, followed by reduction of the first phalanx and fixation of it by two sutures to the second metatarsal bone through a new lateral oval incision. Corrective plaster cast is used for four weeks.

PITZEN (7) explains a technique of operative correction of claw and hammer toes by use of an intramedullary bony graft crossing the joint after position is corrected. This is accomplished by opening the joint, denuding cartilage, and preparing medullary tunnels in both proximal and distal phalanges into which a tibial bone graft is levered.

OSMOND-CLARKE (8) states that callosity formation is due to pressure of the bone from within or the shoe from without. Pes cavus causes pressure

under the heads of the metatarsals and on the dorsum of the proximal interphalangeal joints. In young, exercises for the intrinsic muscles, stretchings, and the use of a metatarsal bar and night splints are recommended. Expert fitting of shoes and attention to the callosities are important. In flat feet and metatarsalgia, one must check all causes of pain and not just the flat feet. For hammer toes, he recommends conservative treatment first, and later the operative treatment. He feels that best results are obtained from tenotomy of the extensor tendons and fusion of the proximal interphalangeal joint. Callosities require much care, consisting of cutting them down, using faradic foot baths, and wearing roomy shoes and metatarsal pads. The best pad is rubber under chamois, held in place by an elastic band, and this should be properly placed each morning. For congenital contracture of the little toe, he does a Z-plasty of the skin and divides the extensor tendon and the capsule.

MENDLOWITZ and ABEL (9) report on the measurement of blood flow in the toe in normal patients and in those who have suffered from trench foot and frostbite. There is significantly decreased blood flow in patients who have suffered from frostbite or trench foot. The authors believe this to be due to organic obstruction or constriction of the small arteries of the foot.

Four of the articles which deal with anatomic deformities are concerned with flat feet. STAMM (10) states that the two ways in which mechanical defects may cause pain of the foot are by excessive pressure on some area or by excessive tension of some tissue. The purpose of fibrous tissue is to prevent excessive movement and not to withstand continuous tension. The ligamentous tissue, nerves, and muscles should work in unison. Failure of this unison results in tension, and it then causes pain. Excessive tension may alter the shape or posture and result in pressure. The arch serves to support the weight of the body without collapsing. The tibialis posterior and the peroneals act as slings for this arch. The ideal foot should be able to support the weight of the body without tension of the muscles other than for balance, but the normal foot requires tone for the support of the arch. The foot should be supple. A supple foot usually is not painful, but a rigid foot does give pain. A pes cavus foot has a good arch, but it is often painful because of stiffness. The types of feet that are painful are the stiff foot, the foot with a long arch, and the one with defective muscle tone. A foot that cannot be fully dorsiflexed can get more dorsiflexion with eversion, and it then looks flat. This often causes pain. Distinction should be made between a true flat foot, which is of no significance, and one due to eversion. A valgus posture does cause pain. If foot strain has lasted for some time, a state of congestion results, and organization of the exudate then occurs. Manipulation of these feet may break up this condition and give relief. An exception to this is the spastic flat foot with spasm of the peroneals.

According to KITE and LOVELL (11), there are various types of flat feet, some of which correct themselves, some of which require manipulations and corrective shoes, and some of which require casts and wedgings. Treatment may indicate corrective shoes with the swung-in toe and the heel raised on the medial side, and possibly run forward some. Shoes should be fitted correctly. The author warns of the danger of the use of the fluoroscope in the shoe stores. Corrections are made more rapidly with manipulations. He gives a very definite method of manipulation, and this must be explained very care-

fully to the mother, being sure that she understands it. Exercises are also given, and these consist of (a) standing pigeon toed and coming up on the toes several times, (b) standing pigeon toed and inverting the foot, standing on the lateral borders, (c) turning the foot down, in, and then up, while in a sitting position, and (d) in cases of short heel cord, standing pigeon toed a short distance from the wall and leaning forward to the wall with the chest, keeping the body straight. If there is poor cooperation, foot plates may be used. For the more severe cases, casts may be applied with the foot in the corrected position. This works well with a pliable foot, but with a rigid foot the casts will probably have to be wedged. There may be outward rotation of the leg, in which cases, manipulation should be attempted. In the more severe cases, however, a bar between the feet with the shoes fastened to the bar is recommended for correction. In some of the most severe cases, stabilization of the foot may be necessary.

HERZMARK (12) emphasizes the importance of early diagnosis of flat feet in infants. The most important point in diagnosis is the appearance of the foot along with the relationship between foot and leg. Outward rotation or pronation of the foot is apparent at birth. The author recommends treatment with plaster boots applied immediately with subsequent weekly changes. Treatment is conducted for a month, this being sufficient in most cases. He also recommends a semiresilient surface for the child's play pen when standing and walking begins. This prevents passive use of the feet as well as automatically exercising them, and the child develops proper walking habits.

HOFFMANN-KUHN (13) points out the etiologic factors in production of flat feet and cavus deformity of the feet. The direction of pull of the tibialis anticus is considered a prominent factor. In the correction of flat feet, bony correction by bone resection at Chopart joints and bone block distraction of the posterior portion of the prepared talo-calcaneo joint are accomplished. These measures produce a laxity of the tibialis anticus at the neck of the talus. In the correction of cavus feet, bony correction is accomplished, and the tibialis anticus is freed from posterior attachments to pull on the dorso-medial surface of the first metatarsal.

Other articles in this category include a discussion of the occurrence of calcaneo-navicular synostosis in pes valgus contracture by HERSCHEL and VON RONNEN (14). They think that it occurs more often than suspected. Pfizner found it present in 2.9 per cent of 520 foot skeletons. In order to eliminate errors in diagnosis of this condition, x-rays are obtained in one more plane than usual, so as to show the pathology. This extra view is taken at an angle of 45° on the lateral side with the plantar surface of the foot on the film. Slomann suggests three forms of this condition: (a) a complete bony bridge, (b) a fibrous cord of syndesmosis, and (c) amphiarthrosis, a kind of stiff joint. The last two cannot be diagnosed by x-ray, but, if the x-ray shows ossa calcanea secundaria and the patient has clinical findings of pes valgus contracture, then the diagnosis of syndesmosis is justified.

HARRIS and BEATH (15) report that there is a specimen of taliocalcaneal bridge in the pathological museum of the Royal College of Surgeons of England.

HARK (16) discusses rocker foot due to congenital subluxation of the talus. A similar condition may be seen due to improper treatment of club

foot. In this, there is an equinus of the calcaneus with dorsiflexion of the forefoot and some valgus. The talus points downward toward the plantar surface of the foot almost parallel with the tibial line. There is a break in the alignment of the mid-tarsal joint so that the navicular faces the dorsal surface of the talus. The cuboid lies above the calcaneus, and the plantar half of the posterior surface is atrophied due to pressure. Previously, astragalectomy has been recommended for this as well as removal of the head and neck of the talus. The author does a third type of operation. He lengthens the Achilles tendon and, if necessary, cuts the capsule of the ankle posteriorly. A Steinman pin is then inserted above the calcaneus anterior to the Achilles tendon, and downward traction can be exerted to eliminate the equinus of the calcaneus. Two parallel incisions are then made on the dorsum of the foot, one over the tarsal sinus lateral to the extensor tendons, and the other medial to the anterior tibial tendon. The shortened fascia on the dorsum of the foot is then cut, if necessary, on the plantar surface also. The tendons of the anterior tibial and extensor hallucis longus are lengthened. The extensors of the toes are also lengthened in a special manner. If necessary, the flexors are lengthened as well. The dislocation is then reduced. A long leg cast is applied with knee flexed to a right angle, the cast extending to the ankle, and it is then allowed to set. With traction made on the pin, the cast is extended to the mid-foot. When this has set, the forefoot is incorporated into the plaster in plantar flexion. At times, circulatory embarrassment may prevent this last step, and, if so, the foot is brought up as much as possible and changed at four day intervals. Sometimes it is necessary to fix the navicular to the talus with Kirschner wires. The thigh portion of the cast is removed in six weeks as well as the pin, and a walking iron is attached. Total immobilization is accomplished for four months. The author reports good results with this procedure.

PULVERMACHER (17) thinks that the highest incidence of valgus foot is in the second year of life, and it is then 91 per cent. The incidence decreases from then on. He finds no relation between knock knees or bow legs and flat feet.

TREVOR (18) discusses tarse-epiphyseal aclasis, first described in 1926 by Mouchet and Belet. He presents seven cases. They all involve the knee, ankle, and tarsal bones. If both bones are involved, the pathology is on the medial side of both bones, or it involves the lateral side of both. No cases are seen involving the medial side of one bone and the lateral side of the other bone. Initial symptoms are swelling or deformity rather than pain. The bony mass from the overgrowth of the epiphysis causes an enlargement of that area. X-ray changes are confined to the epiphysis. They suggest a mass of cartilage tissue with many foci of ossification. The author believes these changes suggest a congenital error in skeletal development as the cause, and he also thinks the limb bud, either pre-axial or post-axial, is affected. The arrangement of the blood vessels in the epiphysis may explain why one side only is involved. Treatment consists of operative removal of the excess bone if it does not jeopardize the stability of the joint.

Four deformities of the foot are discussed by HERSCHEL (19).

MEIER-STAUFFER (20) describes a plantar plastic surgery procedure for a pedicle graft.

The importance of preventive and therapeutic measures is pointed out by BROWN (21) in his discussion of practical foot problems involving the infant, child, and adult. The all or none law, as applied to the use of corrective appliances and active exercises for the infant, child, and adolescent is stressed. Adequate explanation and instruction to the patient or parents, for a complete understanding of the condition and the value of the types of treatment prescribed, is emphasized as necessary for successful treatment. Those conditions due to muscle imbalance require continued treatment after the condition becomes asymptomatic. The author emphasizes physical medicine procedures applicable to the common foot problems.

BOUCHER (22) emphasizes the need for better care of the foot as seen in the number of disorders encountered in children and old people, as well as in examination for the military service. He recommends that the public be educated in the prevention of disabilities and deformities and in the realization of the value of, and quality of, well-fitting shoes.

LEWIS (23) reports on a syndrome of painful feet in American prisoners of war due to avitaminosis. A complete evaluation of history, incidence, and nutritional background of the patients is presented. This condition is seen to be due to a deficient diet for approximately nine months, during which time several deficiency diseases were prevalent, with this syndrome the most outstanding. The symptoms and signs are due to a neuritis, primarily of sensory nerves. The author believes that deficiency of thiamine is the principal, but not the only, factor responsible for the syndrome.

JONES (24) discusses treatment of common injuries of the foot. He writes of the stability of the foot and the mechanism causing it. He discusses the anatomy briefly. Injuries of the foot cause pain, and walking then alters the position of the foot to take pressure off the tender areas. This places a strain on other parts and causes pain. Prolonged use and strain cause muscle fatigue and pain. Valgus strain causes pain on the medial side of the foot and a flattening of the longitudinal arch. Treatment outlined is rest, arch supports, and extension of the heel on the medial side. Anterior foot strain is described as a strain on the anterior arch due to fatigue of the intrinsic muscles. Rest, use of a metatarsal pad or bar, and a toning up of the muscles of the forefoot are recommended therapeutic measures. March fractures should be treated as other fractures. Crushing injuries are treated by debridement and dressings. For hemorrhage under the nail of the big toe, the use of a dental drill to provide a hole for releasing the pressure is suggested. Pads may be of some help in treatment. Metatarsal fractures should be treated with a cast for six weeks. When the cast is applied, it should be well-molded so as to form normal arches of the foot; otherwise, the patient may develop a loss of the anterior arch and get a painful foot. In calcaneous fractures, some physicians treat by attempting to reposition the fragments and hold in a cast for eight to twelve weeks. Others give non-weight bearing exercises for the same length of time and, the author thinks, with better results. In ankle injuries, the necessity for distinguishing between sprains and fractures is stressed. In Achilles tendinitis due to wearing of boots, treatment consists of wearing low shoes for the time and then gradually reverting to the boots with the leather softened first. With a bursa over the base of the fifth metatarsal, removal of the pressure of the shoe hastens healing. He gives a group of exercises, both passive and active, for painful feet.

McCOMAS (25) discusses disabilities of the foot in the infant and young child. Metatarsus varus, talipes calcaneo-valgus, congenital curled toes, elevated toes, hammer toes, pes planus, pes valgus, and pes cavus are discussed and their manifestations and appropriate treatment are presented.

TURNBULL (26) reports a radiological investigation on the weight bearing changes in the longitudinal arch of the foot in 100 students. Under the weight of the body, the medial longitudinal arch undergoes an average depression of two millimeters and increases in length four millimeters. One of the feet, usually the right, betrays a secondary change greater than the other.

OLIVIER (27) reviews the pathogenesis, distinguishing skin contracture, muscle contracture, paralysis, and osteoarticular lesions of clinical forms of phagedenic clubfoot. The following are the sequelae: pes equinus, pes varus, pes equino-varus, and pes talus. Treatment is discussed with emphasis on the prevention of vicious attitude.

Failure of modern footwear to meet body requirements for psychic and thermal sweating is shown by GAUL and UNDERWOOD (28). They present a study of shoes worn by patients with foot eruptions. They conclude that the leather of shoes should be made of material that allows the rapid passage of water vapor so that evaporation from the feet can play its important role in the regulation of foot temperature.

BOOTH (29) proposes a prepaid plan which would supply all children with shoes necessary during their growing period. With proper fitting, he feels that the incidence of hallux valgus would be decreased.

MITBREIT (30) recommends orthopedic shoes for flat feet.

Methods of stabilization in treatment of foot drop are described by MERRITT (31) in a patient with alcoholic neuritis of the peroneal nerve. He reports the use of a special device made of a cast, coat hanger, and rubber bands to hold the foot up.

BUXTON (32) states that flail foot is due to lower motor neuron lesions such as poliomyelitis, sciatic nerve lesions, spina bifida, etc. Careful initial evaluation is of prime importance. Paralysis often does not affect the foot alone; it may involve the leg, and, therefore, the leg as a whole should be considered and not just the foot. Some patients may be better off with amputation. Treatment consists of physiotherapy, care of callosities, special shoes, and appliances. Operative treatment consists of tendon transplantation, bone and joint operations, and amputation. An attempt is made to correct and control the deformities and the instability.

PATTERSON et al (33) report an evaluation of 305 stabilizations for various conditions with success in 82 per cent. Residual deformity and pseudarthrosis account for 51 of the 55 failures, and most of the deformities are due to under-correction. Later, deformity results from removal of the plaster too soon, failure to align the foot properly, or loss of positioning in the plaster at the time of changing of the plaster. Greater success is attained when three joints are fused. Their calculations indicate 47 per cent failure in stabilization on children under eight years of age. Varus and foot drop are the most frequent deformities that remain uncorrected.

They find 18 per cent showing pseudarthrosis, most of these occurring at the talonavicular joint.

On the factor of trauma in foot problems, TYPOVSKY (34) reports four cases of dislocation of the tarso-metatarsal joint. He thinks that it is due to an inherent tendency of this joint in the oblique direction in relation to the long axis of the foot.

HOLSTEIN and JOLDERSMA (35) state that the usual dislocation of the first cuneiform in tarso-metatarsal fracture dislocations is not a problem, but, when there is disruption of the first cuneiform-first metatarsal joint with outward rotation of the first cuneiform and separation of it from the second, there is difficulty, and it requires an open reduction. Fibers of the anterior tibial tendon which remain attached to the first metatarsal become displaced between the first and second cuneiforms. Traction and manipulation do not displace it, and, further, they prevent the reduction of the dislocation.

Among the articles pertaining to specific conditions is an article on the treatment of pseudarthrosis of the scaphoid, inner malleolus, and acromion by HUTHER (36). Arthrosis of the foot is discussed by LELIEVRE (37).

An article by PRATT (38) deals with the osteopathic management of anterior metatarsalgia. POLIVKA (39) reports three cases of Morton's metatarsalgia treated operatively with the usual findings. Microscopic examination shows fibrosis of the nerves and obliterative changes of the corresponding arteries. OTTOLENGHI et al (40) contribute further data on this subject.

MITCHESLL-HEGGS (41) describes the treatment of athlete's foot.

HOSFORD (42) divides the treatment of ingrowing toenail into the following three categories: prophylactic, conservative, and operative. For prophylaxis, it is advisable to wear no shoes that compress the toes or the flesh against the nail. The end of the nail should be correctly cut. Conservative treatment consists of as little walking as possible and the wearing of no shoes other than soft slippers. Insertion of something between the nail and the flesh at the edges is sometimes beneficial. Glycerine may be used on this. Strips may be cut from the edge of the nail, even as far back as the nail bed. In operative treatment, three-eighths of an inch is cut through the thickness of the nail down to the root of the nail. These flaps are dissected up so as to free one-third of the bed. The section of the side down to the base is then cut away, and the base of the nail is curtailed down to bone, care being taken to get all of it. Finally, the skin flap is replaced but not sutured.

BOBROFF (43) presents a case report of plantar warts treated with a keratolytic agent consisting of 40 per cent salicylic acid in plaster. A small piece of plaster is cut the size of the wart and applied to it, held in position by ether plaster. He finds that 20 per cent of cases so treated develop abscesses underneath the wart, the abscesses becoming apparent about two weeks after beginning treatment. It is felt that chemical treatment should be tried before any irradiation begins.

HARO (44) discusses asymptomatic occurrence of ringworm of the feet in Finland.

NUESSLE (45) reports a case of Madura foot, observed over a period of 15 years, and finally resulting in amputation. He feels that amputation is the treatment of choice. Additional information on Madura foot is presented by MEYER (46).

CAMPBELL et al (47) report their follow-up study of 149 cases of thromboangiitis obliterans, about 45 per cent requiring amputation. This compares with previous reports. Superficial migratory thrombophlebitis is shown to precede clinical occlusive arterial lesions. If sympathectomy is to be done, it should be done early in the disease. When the patient remains under rigid supervision of interested physicians, major amputations are reduced to a minimum. The large number of patients who are still living have not ceased the use of tobacco. Psychosomatic factors appear to aggravate the condition.

REDISCH and BRANDMAN (48) evaluate five vasodilator drugs in treatment of chronic trench foot. The drugs are aminophylline, papaverine, etamon, priscoline, and reniacol tartrate. None of the first four mentioned are effective. Reniacol tartrate produces some improvement in 44 per cent with little side effect. Careful clinical examination is the only basis for the authors' evaluation.

Ankle

Various articles appear on traumatic conditions of the ankle. STUCKE (49) considers the elastic behavior of the tendon of Achilles in experimental rupture.

SOMERVILLE-LARGE (50), in discussing strains of the ankle joint, contends that some degree of tilting of the talus on inversion of the slightly plantar flexed foot is normal. Due to the anatomy of the calcaneo-fibular and talo-fibular ligaments, the former is tight on dorsiflexion, and the latter is tight on plantar flexion. HUDSON (51) calls a tibio-fibular diastasis a ligamentous fracture. Examination of the patient after about an hour shows that there is antero-lateral swelling of the ankle, limitation of flexion and extension, no inversion, a tendency to valgus position, a spasm of the peroneal muscles, and an unstable ankle. X-rays, as routinely taken, are negative. When taken with forced inversion, they show that the talus can be rocked out. All these findings and symptoms are aggravated after a few hours. The author's treatment consists of a subcutaneous tenotomy of the peroneals which, he states, gives immediate relief. He then applies a long leg cast for six weeks and then a plaster boot for four more weeks. Patients walk after four weeks in the cast.

VAN de VOORDE et al (52) outline the treatment of the sequels of ankle injuries, and SAHA (53) discusses various injuries of the ankle and their management. (Ed: The latter is a particularly well-presented, detailed article.) The necessity of obtaining proper alignment of the ankle mortise and the satisfactory reduction of supra-malleolar areas are emphasized. The importance of adequate x-rays in cases of injury with pain, swelling, and tenderness in the ankle area is re-emphasized.

NISSL (54) emphasizes the necessity, in acute sprains of the ankle, of determining whether there is actually a sprain. In case the distance between the talus and the internal malleolus is equal to or larger than the width of

the horizontal joint, tears of the ligament can be diagnosed from a single A-P view. CHESNEY (55) states that, in order to get a proper x-ray view of the ankle, one should have the patient lie on the affected side with the sound limb behind the affected one. The ankle is placed on a low box on the table with the foot projecting distal to the box. This prevents any inversion of the foot, which he feels is the cause of some of the failures. The knee is not supported. The tube is directed one-half inch proximal to the lower end of the medial malleolus.

RACKOW (56) suggests four x-ray views of an injured foot. Standard antero-posterior and lateral views are taken. The oblique view is obtained by having the plantar surface of the foot on the film and then tilting the leg medially 45°. The fourth view is taken with the plantar surface of the foot on the film and the ankle in dorsiflexion, the tube being posterior and directed downward toward the calcaneus. Minimal fractures, erroneously called sprains and treated as such, often result in prolonged disability. The author discusses various fractures of the bones of the foot and precautions to be taken in order to avoid mistaken diagnoses.

Preventive and therapeutic measures are presented in two articles. His study of the various methods of strapping and supporting ankles in athletes is reported by MCPHEE (57). He finds figure of eight bandages of adhesive to be the most effective, but they cause irritation of the tibialis anticus tendon. A modified figure of eight with heel support, using muslin, is good. A shoe padded over the malleoli and under the tongue, as suggested by Scott, is also good. A modified Gibney bandage is useful. The author checks these results by x-ray.

SWYNGHEDAUS (58) reports two cases of tibio-peroneal diastasis, both having considerable difficulty. He states that operation, in both cases, consisted of dividing the fibula two inches above the tip, cleaning out the tibio-fibular gutter and then replacing it, fixing it to the tibia with a cross bolt. A rapid cure in both cases is reported.

Numerous specific conditions involving the ankle are illustrated by representative case reports. BISOTTI (59) reviews the few cases of anterior luxation of the head of the fibula which have appeared in the literature and presents a case of his own. His case is unusual in that detailed account of the movements responsible for this injury can be described. He reports it to have been produced by internal torsion of the thigh in which the right foot was unable to follow. His treatment consists of reduction by traction and direct manual pressure under local novocain anesthesia. Complete relief of pain results from reduction. Immobilization is used for 20 days postreduction.

CARTER et al (60) report nine cases of an entity called the anterior tibial syndrome. These patients give histories of strenuous use of the leg muscles just before or at the time of the onset of symptoms, followed by swelling of the anterior tibial compartment, classical signs of inflammation, and, later, foot drop. Two cases followed transfusions into the veins of the leg. The other muscles of the leg remain normal. The affected muscles are hard and indurated, responding neither to galvanism nor faradism. Five cases show silent electromyograms, indicating fibrosis or necrosis of the muscle. Arteriography shows no evidence of thrombosis of a large artery.

Biopsy shows microscopic and macroscopic massive ischemia, necrosis of muscles with replacement fibrosis. The treatment is complete rest, elevation and limb splintage, and early decompression of the anterior compartment as paralysis occurs.

Two cases of leprosy involving the talus are reported by ERICKSON and MAYORAL (61), both cases showing osteolytic lesions. Since this has not previously been reported in the literature, routine x-rays on 441 patients with leprosy are used for clarification. Five of these patients show previously unrecognized lesions of the talus, occurring in the neck of the talus, usually at the junction of the neck and the body at the site of the best blood supply, and only in patients with lepromatus or mixed leprosy. Healing of the lesion is accomplished fairly rapidly if weight bearing is prevented during the healing phase.

SIMPSON (62) reports a case of osteochondritis dissecans of the talus, including operative findings and postoperative results. Satisfactory outcome is reported. He reviews the literature and finds few other cases of this type reported.

ROCA and ANTELO (63) present a case of complete dislocation of the talus antero-laterally with inversion of 90°, satisfactorily reduced with a good functioning foot.

WOLIN et al (64) feel that persistent or recurrent pain and swelling over the fibular aspect of the ankle joint are, not infrequently, residuals of an old inversion sprain. The patient may describe it as a weak or trick ankle. The authors feel that this is not usually due to a tearing of the ligament. There is some tearing of tissue with a sprain, accompanied by hemorrhage. This usually subsides, but occasionally it does not. It gives rise to a traumatic synovitis with synovial thickening and exudation. Part of this tissue may remain between the malleolus and the talus where it may become hyalinized. Pinching of this tissue frequently causes pain and swelling. This is called a meniscoid lesion, and, with its removal, the patients get complete relief. They report success in nine cases.

Non-specific inflammatory lesions of tendons are divided into three groups by LAPIDUS and SEIDENSTEIN (65). The groups they name are peritendinitis, stenosing tenosynovitis, and chronic tenosynovitis with effusion. In peritendinitis crepitans, there is a deposition of fibrin in the peritendinous and perimuscular areolar tissue. It is often of an occupational nature. Crepitus can be felt, and it is worse early in the morning. Rest and physiotherapy invariably relieve the condition. Stenosing tenosynovitis occurs only in tendons with a synovial sheath. This is most often seen at the radial styloid process, involving the tendons of the abductor pollicis longus and extensor pollicis brevis. It may also occur as a trigger finger on the palmar aspect of the metacarpals. Some early cases get relief with rest, but most of them require surgery. Most commonly, a chronic effusion in the synovial sheath is due to tuberculosis. The sheath is distended with fluid and contains typical rice bodies. Tuberculosis and suppurative forms are not included in this third class, however. A chronic tenosynovitis with effusion most often involves the Achilles tendon. The symptoms may be present intermittently, and the condition may go unrecognized even for years. At operation, it shows an increase in synovial fluid with thickening of the sheath.

Luster of the tendon is gone. Some have a purplish discoloration. The author excises most of the sheath, and the patient obtains relief following this procedure.

One case of rupture of the tendon of the tibialis anticus muscle is described by STRASSBURGER (66). This is apparently rare, as he found only six other cases reported in the literature.

GIRDWOOD (67) discusses gravitational leg syndrome. He states that excision of an ulcer, including the surrounding scar tissue and the deep fascia, and exposure of the underlying muscles, followed by skin grafting, is the treatment of choice. In 20 divisions of the superficial femoral vein, 13 show no change or an aggravation. Seven are much improved.

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CHAPTER XVI

CONDITIONS INVOLVING THE SHOULDER AND NECK

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- I. Shoulder joint
 - A. Operative techniques
 - B. Arthrography
 - C. Painful shoulder conditions
 - 1. General
 - 2. Bursitis
 - 3. Capsulitis
 - D. Dislocation of the shoulder
 - 1. Surgical treatment
 - 2. Fracture dislocations
 - 3. Unusual cases
 - E. Miscellaneous conditions
- II. Shoulder girdle
 - A. Acromio-clavicular area
 - B. Scapular region
 - C. Muscular involvement
- III. Neck
 - A. General discussion
 - B. Cervical spine
 - C. Muscles
 - D. Nerves
 - E. Cervical rib

There are 76 articles reviewed in this category.

Shoulder Joint

Operative techniques are suggested by two authors. A transacromial incision for exposure of the shoulder joint is described by THATCHER (1). It is a simple operative procedure for safe exposure of the superior aspect of the gleno-humeral joint which assures adequate exposure for repair of torn tendons.

HUARD and MONTAGNE (2) describe the anterior approach to the whole hu-

merus from the shoulder joint down, crediting it to G. Mason (British Journal of Surgery, 1929).

Arthrography of the shoulder joint is discussed by KESSEL (3), who uses 8 to 10 cc. of 35 per cent pyelosil in his technique. 25 satisfactory examinations are the basis for his disagreeing with Nevasier's view that adhesions exist between the synovial membrane and the head of the humerus. He also disagrees with Lippman's premise that the underlying lesion in a "frozen shoulder" is bicipital tenosynovitis. The author further conjectures that the gleno-humeral joint may be a "blameless structure, much aligned" and the acromio-clavicular joint may be the origin of many so-called supraspinatus disorders.

WARRICK (4) wisely champions true lateral projections of the gleno-humeral joint. He describes a supero-inferior projection and its counterpart, the infero-superior projection.

Numerous articles appear in the literature pertaining to various aspects of painful shoulder conditions. A summary of treatment of 540 patients with painful shoulders is presented by HARMON et al (5). These are cases selected from a larger group of some 1437 cases seen over a four-year period. The sub-deltoid bursa is felt not to be a factor in the painful shoulder syndrome. The author states that 292 cases, or 54 per cent of the total number, are frozen shoulders; 130 are due to calcifications in the rotator cuff tendons. Bicipital tendinitis, supraspinatus tendinitis, or ruptured supraspinatus account for the remaining cases presented. Many types of treatment are used and evaluated. The following conclusions are drawn: (a) surgical excision of calcifications about the shoulder joint affords the most prompt and effective relief of symptoms, and there is no evidence that roentgen therapy itself causes a disappearance of calcified deposits, (b) manipulation of stiffened or frozen shoulders under general anesthesia and a regime of post-manipulative exercises result in a normal range of motion. These measures give a high percentage of cures with little or no subsequent disability; however, the recovery period may take several weeks, (c) lacerations or tears of the supraspinatus tendons should be repaired surgically, and (d) roentgen therapy may be used to relieve acute shoulder pain, but there remains a high percentage of patients that are unrelieved by this method. It is advised that rest, hot or cold applications, and ethyl chloride spray be used in preference to x-ray. Local procaine injections are inferior to other methods, and diathermy frequently accentuates the patient's symptoms.

The results of treatment of subacromial bursitis in 340 cases is offered by CALDWELL and UNKAUF (6). These authors evaluate the results of various therapeutic measures including one per cent procaine infiltration, roentgen therapy, and surgical excision (all with physical therapy as an adjuvant) in these followed-by-mail cases. They conclude that satisfactory relief of pain and restoration of function may be obtained by conservative measures in 70 to 85 per cent of cases. Roentgen therapy is effective in 85 per cent of cases, and physical therapy alone is adequate for many mild or subacute chronic cases. Recurrent attacks can be anticipated in 22 per cent of acute or subacute cases and in 33 per cent of cases with chronic symptoms. Operative attack on the old, severe, frozen shoulder type proves most effective.

A total of 354 cases of peritendinitis calcarea of the shoulder are analyzed by GALLUCCIO and HERSCHER (7). In these cases, slightly more than half being in females, no definite etiological factor is demonstrable. Typically, an acute case presents severe pain about the shoulder with radiation to both neck and arm. Limitation of motion, particularly abduction, and exquisite point tenderness over the area of the greater tuberosity of the humerus are classical findings. Roentgenographically, the majority of cases reveal calcific deposits near the supralateral aspect of the humeral head, and x-rays should be taken with the hand in both extreme pronation and supination to avoid missing calcific areas. The absence or presence of calcification and the degree of calcification, if present, are not criteria as to the acuteness or severity of the attack, but cases without demonstrable calcification do not ordinarily respond to therapy as dramatically as do those with calcification. The authors believe x-ray therapy to be the treatment of choice, especially in the acute and subacute stages of the disease, although the precise reason for relief of pain following exposure to x-rays is not clear. The dosage advised is 300 roentgens (measured in air) using a 10 x 15 cone at 50 centimeters distance. This is administered to the anterior portal every other day. The authors report their results with the above treatment, administered to 219 acute cases. Complete relief is obtained in more than 80 per cent, 50 per cent improvement of pain and range of motion in 15 per cent, and no relief in 5 per cent. 70 per cent of 111 subacute cases show relief, while less than 40 per cent of 24 chronic stage cases experience any degree of improvement.

Roentgen therapy for bursitis of the shoulder is described by RUBIN (8) and ROBINSON (9) with details of diagnosis, amount, and technique of radiotherapy. For x-ray treatment purposes, the latter classifies the cases as acute or chronic although there is no definite line of demarcation, and he excludes such conditions as rupture of the supraspinatus tendon and acute traumatic bursitis. All patients suspected of having bursitis should have roentgenograms taken with the humerus in internal and external rotation. Although a gross calcific deposit lateral to the greater tuberosity is one of the most positive roentgenographic findings supporting the diagnosis of bursitis, neither its size nor presence or absence is related to the severity of the symptoms. In suspected cases, one should also consider arthritis, fracture of the humerus, neoplasm, inflammatory changes, herpes zoster, calcinosis universalis, angina pectoris, neuralgia, brachial plexus syndrome, cervical spondylitis, tuberculosis, and syphilis. The author's treatment schedules and data are presented. He records a satisfactory response in 83 per cent of 61 cases treated with deep roentgen therapy.

LANDA BACALLAO and DIEGO CABALLERO (10) discuss iontophoresis in the treatment of acute subdeltoid bursitis.

On the subject of capsulitis, there is a scholarly treatise by FISCHER and LEATHERMAN (11) dealing with acute, subacute, and chronic tendinitis of the musculo-tendinous cuff of the shoulder in a concise form.

BURMAN (12) reports a "proven at surgery" case of an enlarged coraco-cromial ligament responsible for compression of the supraspinatus tendon and simulating supraspinatus tendon tear syndrome. Microscopic examination, however, shows extensive degeneration of the tendinous and capsular tissue.

SEZE et al (13) present two cases of bicipital tendinitis which give all of the findings of a subdeltoid bursitis with the exception of exquisite point tenderness over the bicipital groove. In each case, they obtain excellent results by modifying Codman's procedure slightly. The authors' procedure exposes the bicipital tendon where, in each case, they find a chronic inflammatory synovitis surrounding the normal bicipital tendon. One revealed cartilaginous metaplasia of the synovia. The intertuberous ligament is incised and its edges sutured to the tendon with two strong linear sutures. The tendon is then severed above these sutures, and the proximal fragment is allowed to retract. They report that both patients were able to return to full work with strength commensurate with their jobs, one a laborer and the other a secretary. Ranges of motion are reported as only slightly limited with normal to slightly diminished strength of the biceps.

JAMPOL (14) gives exercise treatment for the frozen shoulder in an abstract of a master's thesis from Stanford University Division of Physical Therapy entitled "The Exercise Program for the Shoulder with Limited Motion." It is thorough and complete in its presentation.

Humero-scapular periarthritis is described rather completely and thoroughly by STENGER and GUSE (15) with special emphasis on etiology, diagnosis, pathology, treatment, and prophylaxis. Treatment is chiefly by various kinds of heat, light, and exercises. RENE (16), on the same topic, gives a comprehensive treatise considering the diffuse and localized forms of the condition and all known types of preventive and curative measures, and REYMOND (17) treats the subject from anatomic, pathologic, and clinical points of view. The latter also describes a technique of novocain infiltration in treatment.

SEZE et al (18) present a philosophic discussion of supraspinatus tendon calcification and state that the application of ice exerts a favorable effect in the disappearance of such calcification. They explain that the cold contracts the arterioles, causing poor elimination of the by-products of cellular metabolism which, in turn, produces a certain degree of acidity. It is known that an acid pH favors dissolution of calcium deposits.

GOUNARIS (19) gives a brief resume of the technique of radiotherapy of scapulo-humeral periarthritis.

FEROND (20) describes the technique of tetraethylammonium therapy of pain in the shoulder. This substance paralyzes the sympathetic synapses, thus giving a temporary chemical sympathectomy and parasympathectomy.

DUFOUR and BOISSY (21) report x-ray treatment of four shoulders and one hip with calcifying lesions, resulting in relief of symptoms.

Dislocation of the shoulder is a common topic for study and discussion. TOWNLEY (22) gives an excellent presentation defending Bankart's premise of anterior capsular lengthening or defect being responsible for recurrent anterior dislocations of the shoulder.

JENS (23) advocates the Magnuson procedure for reducing recurrent dislocations of the shoulder. He describes the method and evaluates the favorable results of 11 cases. PALUMBO and QUIRIN (24) discuss the anatomic fea-

tures, pathologic features, and various operative procedures relative to recurrent dislocations of the shoulder. They offer 13 cases in which very slightly modified Magnuson-Stuck procedures were performed and the patients followed for six months to three years. Conceding the brevity of the follow-up period, they report no recurrences to date.

The end-results of 12 cases of old (existing longer than a few weeks) dislocations of the shoulder are evaluated by RUCKER and CAVALCANTI (25) who conclude that ankylosing methods of therapy are preferable since open operation is necessary for reduction although the latter is difficult to maintain. They also state, however, that under special circumstances, principally in old people, the resection of the humeral head can be done because of its simple techniques.

CASTILLO (26) describes in detail the technique of treatment of recurrent dislocation of the shoulder by the Gallie-Lemesurier technique and relates his experience in 11 cases treated by this fascial sling operation. COVILLE (27) describes treatment of recurrent dislocations of the shoulder by suspension of the humerus to the acromion using a ligament of silk. LE-PINE and LANGEVIN (28) report the results of 39 recurrent dislocations of the shoulder operated upon by one of the following three methods: a bony buttress, Nicola's method, or method of Putti-Platt. SCHIER et al (29) present a two paragraph discussion of the operation of Nicola and a patient treated by this method.

A series of unusual fracture-subluxations of the shoulder joint is reported by THOMPSON and WINANT (30). Their study is based on six case histories collected from January 1947 to July 1948, representing an incidence of 20 per cent of fractures occurring about the shoulder joint. They feel that these fracture-subluxations of the shoulder joint should be classified as an entity in themselves. Following experimental work in which they disprove Fairbank's theory of muscle relaxation about the shoulder joint as an etiological factor in this condition, the authors conclude that fracture-subluxations of the shoulder joint constitute a primary stage of a fracture-dislocation of the humeral head with partial tearing of the capsule. They feel that early surgery is not indicated, in that the condition tends to improve spontaneously with proper treatment such as sling support and early horizontal gravel exercises. Hanging cast therapy has no place in the treatment of this entity.

MICHAELIS (31) describes a case of internal rotation type dislocation of the shoulder discussing the difficulty in demonstrating it by radiological techniques (unless a vertical view is obtained). The clinical picture of locking of the arm in adduction in inward rotation is the basis of diagnosis.

HOWELL (32) discusses and pictorially presents patients who, in the quiescent phase of rheumatoid arthritis, develop limited shoulder function, on occasion quite severely, due to supero-anterior subluxation of the head of the humerus, the latter articulating with the acromion and clavicle and creating a false joint. Treatment attempted is weekly novocain into the "new" joint and manipulations. Keen evaluation of this therapy is not included, however.

Among the miscellaneous conditions involving the shoulder joint is a description of rupture of the musculo-tendinous cuff of the shoulder by ASHERMAN (33). He enumerates the diagnostic signs as (a) absence of restriction of passive motion, (b) presence of atrophy of muscle, involved in two weeks, (c) wide separation of tuberosity fracture fragment. Dependable signs, though not diagnostic, are absence of calcium deposits, palpable rupture, and soft tissue crepitus. The author advocates the use of a sling or swath for two weeks before deciding to do surgical repair. Surgical intervention should be done if symptoms and disability are severe after a period of two weeks. He quotes the study of McLaughlin on 100 tears of the cuff repaired surgically.

LADURON (34) reports a case of extensive destruction of the humeral head replaced by a metallic prosthesis. The prosthesis comprises about one-third of the length of the bone, and at its lower end there is a long, cup-shaped recess containing the humeral shaft. The destruction is reported to be due to a shotgun wound, and the many lead pellets in the region seem to have no adverse effect upon the stainless steel prosthesis.

MILLER and HILKEVITCH (35) review the literature on osteochondritis dissecans of the shoulder joint and report one case treated by excision. The pathology, gross and microscopic, is presented.

Shoulder Girdle

Articles concerning the acromio-clavicular area include a description by TARRANT (36) of a method of procuring an axial view of the clavicle.

NATHANSON and SLOBODKIN (37) describe acromio-clavicular changes in three cases of hyperparathyroidism and conjecture the possibility of its being a presumptive sign.

ALEXANDER (38) offers a "shoulder forward" lateral x-ray technique to facilitate radiographic demonstration of dislocation of the acromio-clavicular joint.

TYPOVSKY (39) reports two cases of clavicle extirpation for tumor and carcinoma metastasis. There is no post-operative shock, the period of invalidity is short, and the functional results are excellent.

Two cases of luxation of the sterno-clavicular joint are reported by STAPELMOHR (40) for which he uses a method of surgical treatment which he described in the same journal in 1932.

REYMOND (41) writes an addendum to a previous publication on the occasion of having read the technique described by Urist employing a plaster cast with an elastic webbing strip in treating acromio-clavicular luxations. BOHLER (42) describes the treatment of acromio-clavicular dislocations with a temporary pin transfixation.

The syndrome of snapping of the scapula is reviewed by MILCH (43) who presents the several etiological factors which may cause it. Four cases are presented illustrating the different causative factors. One is a case with a typical bulbous thickening at the upper angle of the scapula which is felt

to represent a tubercle of Luschka. The second is found to be due to a typical, benign osteochondroma in a 13 year old child. The third case, in a three year old female, is found to be due to a congenital malformation of the sixth and seventh cervical spinous processes with a bony projection from this area toward the angle of the scapula. The last case is found to be due to a simple anterior angulation of the superior angle of the scapula which crepitated over the posterior aspects of the ribs on motion. The author suggests that the last case presented represents the most usual finding in the ordinary case of snapping of the scapula. The remaining cases may vary as to etiology and character. Trauma may seem to play some part in the precipitation of the patient's symptoms. The crepitus originates as a result of the contact between the chest wall and the scapula. Elevation of the scapula from the chest wall leads to immediate cessation of the sound and is an excellent diagnostic point. In all cases, the localization of the noise determines the site of resection. Simple removal of the portion of the scapula involved, as in the cases presented, will result in prompt and permanent cure.

The scapular region is the site of injury in a case report by LARGHERO YBARZ (44). He reports the penetration of the axillo-scapular pyramid, anterior to posterior, by a wooden pole, the firm fixation of the pole in the tissues necessitating surgical removal. X-rays reveal that the thorax had not been entered and that there were no rib fractures. Clinical examination reveals that the neurovascular bundle of the axilla had not been damaged. The author reports surgical removal of the pole with wide debridement. Surgery reveals the destruction of the mid-portion of the scapula by the traumatic agent causing extensive damage to the scapular muscles. A satisfactory postoperative course is reported.

Muscular involvement in shoulder girdle conditions is shown by HAYES (45) in his study of rupture of the pectoralis major muscle, a rarity as compared with ruptures of other voluntary muscles. His study is based on the case reports in the literature, a number of which he summarizes, and two cases of his own.

Neck

A general discussion of the differential diagnosis of shoulder-arm pain is given by MORSIER (46) who outlines his treatment. He believes (a) that osteopathic manipulations are correct in a certain number of cases, (b) that x-ray treatment has some place, but it is useless to use more than six or eight applications, and (c) that head traction is still reliable, but if signs of compression persist after several months of conservative treatment (which rarely happens) it is necessary to advise laminectomy.

BAUMANN (47) gives a dissertation on the anatomy of the cervical vertebral column from the point of view of its movements. He clarifies his article by diagrams.

A technique of radiology of the cervical spine is described by SARSIN and GARCIA-CALDERON (48). For the antero-posterior view, they recommend an ascending one at an angle of 20° from the horizontal which corresponds to the inclination of the vertebral bodies. They state that when the angle is correctly chosen the vertebral bodies are well separated and the interverte-

bral spaces neatly recognized. They also recommend profile and oblique views. In discussing treatment, they mention ultrasonic therapy as the newest, but they have not had the opportunity to treat patients with it. They do not speak too enthusiastically about x-ray therapy.

SAINT (49) presents numerous case histories, in the form of a clinical atlas, of swellings of the neck, primarily in the submaxillary triangle. The cases include brachial dermoid, tuberculous glands, late secondary syphilis, gummas, von Mickulicz disease, lymphatic leukemia, Hodgkin's disease, obstruction of Wharton's duct by a calculus, papillomata, hygroma, mixed tumors of the submaxillary gland, secondary carcinoma in the submaxillary gland, and multiple epitheliomata. The final case is that of a fibrous dysplasia of the mandible with a large projecting extension filling most of the submaxillary triangle. Although a clinical diagnosis of sarcoma was suggested, microscopic sections reveal a typical structure of a fibrous dysplasia of bone.

One of the disorders referable to the cervical spine, less frequently reported than others, is prolapse of the nucleus pulposus in the cervical region, accompanied by compression of the spinal cord. ISBISTER (50) discusses the condition and reports a case. The author maintains that the clinical picture of this syndrome does not appear in standard texts, and, therefore, the diagnosis is undoubtedly missed frequently. The author briefly reviews the literature beginning with Adson (1925) and including Stookey (1929), Schmorl (1929), and Andre (1929). The propensity of the lumbar and cervical regions to be the site of prolapsed discs is explained anatomically and is the reason for clinical signs often indicating a level one or two segments below the actual lesion. The pathogenesis is briefly mentioned with the two principal theories. The most frequent clinical feature is insidious onset of cord symptoms often preceded by root pain. Sensory loss and muscle wasting are minimal with root compression. A Brown Sequard syndrome is produced when the cord becomes compressed. The cerebrospinal fluid may show elevated protein and positive Quechendstedt test, but often it is normal. On roentgenography, certain points should make one suspicious of a prolapsed disc. Negative findings are more important here than in the lumbar area. A-P, lateral, and both oblique views are necessary. The value of myelography is not universally agreed upon. Other diagnoses to be considered are mentioned. Treatment is conservative in pure root lesions and surgical when signs of cord compression are present. One case is reported in detail, the patient having a sudden onset of pain and weakness in the right arm followed by paresthesia in the left leg. A laminectomy was done, and a herniated nucleus pulposus was found and removed with almost complete recovery. The author describes the anatomy, pathogenesis, and pathologic roentgenographic findings in prolapsed cervical nucleus pulposus. He describes a case in which the diagnosis was missed for six months, and he stresses the importance of being familiar with the syndrome.

LIEVRE (51) discourses on the pathology of the cervical discs from the points of view of symptomatology in cases of discs with different locations, diagnosis, and treatment. It is illustrated by two case reports.

RICAHD and GIRARD (52), in a paper entitled "Cervico-brachial Neuralgias," discuss cervical discopathies. The tests they consider important are the compression test of Spurling, which exacerbates the pain, and forceful traction, which relieves it. They outline orthopedic treatment as consist-

ing of immobilization achieved by bed rest, a Minerva jacket, a Thomas collar, or traction. They regard chiropractic maneuvers as dangerous. Surgical treatment can be direct intervention by laminectomy, intervention at a distance by scalenotomy, and indirect intervention by sympathectomy and resection of the occipito-temporal, and sometimes the external carotid, artery innervation.

GISPERT (53) writes on the possibility of confusing the diagnosis of amyotrophic lateral sclerosis with various processes which may compress the cervical spinal cord including ruptured discs. He has attempted to establish a diagnostic standard consisting of sensory tests as well as manometrics and myelography.

GHERSI and FERRE (54) report a case of brachial neuralgia from protrusion of the sixth cervical disc, treated by a combined neurosurgical and orthopedic operating team by excision of the disc. Further case reports are presented by RIZZOLI et al (55) and SHELDEN and PUDENTZ (56).

Head and neck pains of cervical disc origin are discussed by SCHULTZ and SEMMES (57) and RANEY et al (58). The latter discuss four supposed sources of posttraumatic headache and state evidence for or against each. They are: (a) intracranial structure, (b) the skull, (c) the scalp, and (d) cervical spine. The authors feel that much headache is due to ruptured cervical discs since in almost every instance of head trauma, some force is transmitted to the neck structures. They feel the headache is not produced by the disc primarily, but rather is secondarily due to mechanical factors involving surrounding structures. They feel that this type of chronicity is in keeping with the slow healing of this structure. The authors conclude that posttraumatic headache is often unexplainable on the basis of scalp, skull, or intracranial lesions. The posttraumatic syndrome has been duplicated by injecting irritating solutions into the upper cervical and suboccipital regions. There is clinical evidence to support the cervical region as a locus for pathology-producing headaches. Cervical arthritis, myositis, fibrositis, and ruptured intervertebral discs are etiologic agents.

OVERTON (59) reviews the literature on degenerative arthritic changes in the cervical spine with associated nerve root pain. This is followed by an analysis of 123 consecutive cases of cervical root pain. 78 report pain referred to the shoulder girdle or upper extremities, while seven present symptoms and objective findings to warrant a diagnosis of a ruptured intervertebral disc. Conservative management such as traction, good sleeping posture, heat, massage, and x-ray therapy has given very good results. Surgery has not been required in any of the cases.

In two articles recording his findings in a clinical study of cervical rheumatism, COSTE (60,61) classifies it as follows: (a) acute articular rheumatism, (b) infectious rheumatism, (c) allergic rheumatism, (d) chronic polyarthritis, (e) ankylosing spondylitis, and (f) cervical arthrosis. The last classification is subdivided into cervico-brachial neuralgia, scapulo-humeral periarthritis, reflex dystrophy of the upper extremity, night pain, thoracic pain, and head symptoms. He discusses these various conditions from the point of view of anatomy with dermatome distribution and sclerotome distribution of Kellgren. He also covers thoroughly the divergencies in treatment.

The existence of a syndrome known as the "stuck joint syndrome" is postulated by STONEHILL (62), said syndrome being a possible explanation for such clinical entities as headache, crick stiff neck, neuritis of the arm, occipital neuralgia, cervical radiculitis, the scalenus anticus syndrome, and the pathological disc. It is stated that the common origin of the above is a "stuck" posterior cervical joint, in other words, a joint whose motion is partially or completely restricted with or without gross anatomic or pathologic findings in the joint or its capsule. There are four clinical findings which direct attention to the possibility of the existence of a "stuck joint." They are (a) restricted mobility of the cervical spine and pain on forced movement of the apophyseal joint, manifested on chin to shoulder, ear to shoulder, and chin to chest maneuvers, (b) pain elicited by palpation of the joint capsules which aids greatly in localization of the affected joint, (c) tenderness at the insertions of muscles arising in close relation to the joint, i.e., levator scapulae and scalenus anticus, and pain at the occiput laterally and just below the superior nuchal line, and (d) radiographic evidence of deviations from the normal cervical spine, i.e., altered normal spinal curvature, ill-defined joint interspace, rotated vertebrae, failure of the "stuck" joint to open as widely as normal in flexion or close as completely as normal in extension, and distortion of the intervertebral disc.

SHEEHAN (63) treats the affected muscles in acute stiff neck due to exposure to cold drafts with ethyl chloride spray to the overlying skin area. This is done in conjunction with massage of adjacent area, followed by gradual increase in range of motion. Of 30 cases, 29 are reported to have obtained complete relief in five minutes and one was worse the following day.

BROWN et al (64) describe and advocate the method of excision of the entire sterno-cleido-mastoid muscle, rather than muscle section (myotomy), in selected persistent cases of torticollis. In a subsequent article in a different journal, BROWN and McDOWELL (65) reiterate their findings and conclusions.

A case history, as presented by PEIKOFF (66), represents the typical findings of the scalenus anticus syndrome, either with or without a cervical rib as a complicating factor. Symptoms and signs presented are subclavian artery insufficiency and compromise in normal function of the lower trunks of the brachial plexus as demonstrated by impairment of median and ulnar nerve function. It is of interest that early in her course the patient's condition was mis-diagnosed as ulnar palsy, but by demonstrating differences in blood pressure and radial pulses of the left and right arms, as well as positive Adson's maneuver, it became evident that the pathology lay more proximal than the left medial humeral condylar area. Description of scalenotomy emphasizes the necessity of accurate identification of structures when doing dissection in the neck. This is especially true when separating the scalenus anterior from its insertion on the first rib so as to avoid injury to the subclavian artery posteriorly and the pleura medially. It is necessary to insure division of all muscle fibers so that the subclavian artery and/or involved nerves are seen to be free of pressure. In spite of marked muscle atrophy, paresis, and tendency of the patient to maintain "mainen-graffe" position of her left hand, rapid recovery is seen following scalenotomy with perfect anatomical and functional result four years postoperatively.

TINOZZI (67) gives a scholarly discussion interpreting the work of auth-

ors in other countries with two case reports to illustrate the syndromes of the suprACLAVICULAR angle.

ARSENI and MARCOVICI (68) report the results of 26 cases of spasmodic torticollis treated by what they describe as posterior rhizotomy with amelioration in the majority of cases. KLIMA (69) reports two cases of torticollis ocularis.

Four articles on conditions which involve nerves of the cervical region are reviewed. Brachial neuralgia is reviewed by PHILIP (70) in outline form with typical case presentations of 42 cases. The importance of the neurocentral joint is stressed, differential diagnosis is discussed, and therapy is outlined. In the JOURNAL DES PRATICIENS (71) is outlined the conservative treatment of cervico-brachial neuralgias as immobilization, traction, manipulation, medication, and physio-therapy. SILLEVIS (72) writes a short dissertation on brachial neuralgia including the scalenus anticus syndrome, humero-scapular periarthritis, and cervical migraine. SEPICH and SAGASTUME (73) report a case and discuss the medico-legal considerations of partial paralysis of the brachial plexus due to traumatic stretching. They also report a posttraumatic psychoneurosis in their case.

The occurrence of a cervical rib is discussed by POPPEN et al (74). They give a comprehensive presentation of the subject from the standpoints of anatomy, pathology, symptomatology, and diagnostic aids. They analyze a series of 58 cases, including case reports of three cases of unusual interest. Non-operative as well as operative methods of treatment for this condition are discussed. Of interest is their analysis of 58 cases gathered from 115 cases of scalenus anticus syndrome seen over a ten year period. The preponderant number are females, in a ratio of seven to one. Operative procedures of rib resection, anterior scalenotomy, medial scalenotomy, and sympathectomy, performed at single or combined procedures, achieve good results in 50 patients, while six show fair results, and two show poor results with no improvement following the operation. A history of trauma is obtained in 11 patients who previously had been asymptomatic. These seem to substantiate the statement that cervical ribs occur in 0.03 to 0.1 per cent of the total population, and that 5 to 10 per cent of these individuals are symptomatic. In cases which do not respond to conservative, non-operative treatment, exercises designed to elevate the shoulders and bring them forward, thereby relieving pressure on nerve and vascular structures in the neck region, are recommended. Surgical intervention in the forms previously described is advocated. Removal of the upper three dorsal sympathetic ganglia on the symptomatic side greatly benefits patients with marked vasomotor changes in the homolateral extremity.

WERTHEIMER and ALLERGRE (75) ascertain, from observations of nine cases of cervical syndrome, the important role of the sympathetic factor in the genesis of vascular and nervous disturbances occurring in patients suffering from such a malformation. If anatomical lesions are missing, sympathetic surgery seems the best course. Rib resection alone is not able to bring recovery. Six patients in their series show improvement after sympathetic operations (periarterial sympathectomy, stellectomy, "under-stellectomy"). If arterial lesions, local or distant as shown by arteriograms, are found, arterial surgery is necessary.

PURVES and WEDIN (76) make an interesting report of a mother and father who had 13 ribs on one side and 12 on the contralateral side. In the father, the cervical rib appears on the right, and in the mother, on the left. Five of 11 children have bilateral cervical ribs. All of these patients are asymptomatic as regards their cervical ribs.

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CHAPTER XVII

FOREARM AND HAND

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- I. The elbow and forearm
 - A. Loose bodies
 - B. Muscles
 - C. Monteggia fractures
 - D. Epicondyles
 - E. Bony ankylosis
 - F. Miscellaneous
- II. The wrist and hand
 - A. Neurovascular
 - B. Neuropathy
 - C. Tendons
 - D. Wrist joint
 - E. Carpal lunate
 - F. Carpal scaphoid
 - G. Carpal-metacarpal joints
- III. The hand and fingers
 - A. Infections
 - B. Hand surgery in general
 - C. Skin plastic procedures
 - D. Reconstruction of digits
 - E. Dupuytren's contracture
 - F. Miscellaneous

Out of World War I emerged orthopedic surgery in its present form. Out of World War II, surgery of the hand. Up till then surgery of the hand was practiced by individuals or furthered by groups like Sumner Koch and his coworkers in Chicago. But it was up to Sterling Bunnell to teach and establish the specialty on a national and now international basis. Whether he be quoted or not, his principles are reflected in every one of the 100 articles which follow.

The Elbow and Forearm

Loose bodies of the elbow joint are discussed by MORTON (1). He pro-

poses a classification into four groups:

Group I: Loose bodies in pathological joints (Osteoarthritis, neuro-pathic joints, tuberculosis, acute infections).

Group II: Loose bodies from tumor formation.

Group III: Loose bodies from congenital or developmental origin.

Group IV: Loose bodies of traumatic origin.

The literature covering the first reports on various conditions is reviewed and the article illustrated by three cases.

The medicolegal aspects of one case of osteochondromatosis of the elbow are analyzed by LINO (2). He feels that trauma did not cause the condition but aggravated it.

A case of osteochondritis dissecans of the supratrochlear septum of the humerus is described by VON RONNEN (3).

Under the section of muscles is included an article by SEDDON (4) describing the transplantation of the pectoralis major for paralysis of the flexors of the elbow. The operation was previously described by Clark in 1946. The lower one-third of the pectoralis with a continuous piece of rectus abdominis sheath is elevated. The separate blood and nerve supply of this portion is carefully preserved. A wide tunnel in the arm is necessary to maintain the blood supply of the transplant. The rectus sheath is anastomosed then to the distal biceps tendons. The angle of choice at the elbow is 30 degrees above the right angle. 16 operations were performed with worthwhile to excellent results.

GOOD (5) discusses a well known syndrome referred to as acroparaesthesia which is found usually in middle aged fatigued women, engaged in manual work. It is characterized by referred pain, paraesthesia, and so-called "myalgic spots" which are very tender to pressure. The author feels that it is an etiopathic myalgia and can be cured in a short time by injecting 1-2 cc's of procaine accurately into each myalgic spot.

Anterior Monteggia fractures according to EVANS (6) consist of: (a) fractures of the ulna in its middle third, with backward angulatory deformity and anterior dislocation of the head of the radius, (b) fracture of the ulna in its middle third with a high fracture of the shaft of the radius, (c) anterior dislocation of the head of the radius without fracture of the ulna. The author is of the opinion that this fracture is produced by falling on the outstretched hand with the arm well pronated. Experimentally, the author subjected 18 forearms to stresses between a wooden clamp and vise to determine the mechanism of anterior Monteggia fracture. In 12 specimens he obtained a fracture of the middle third of the ulna, and dislocation of the head of the radius. 11 cases of Monteggia fractures were studied in this report. The treatment used by the author was that of placing the patient under deep anesthesia, pronation of the forearm, and manipulation of the head of the radius with plaster of Paris immobilization. Two of the patients in this series had to be operated upon for late treatment and epiphyseal sep-

aration. In 10 of 11 cases, a normal range of motion was attained. Poor function was encountered on the avulsed radial epiphysis.

Next, the epicondyles are considered. MORAES (7) points out that in animals from the reptiles to the apes, the brachial artery and median nerve pass through a subepitrochlear foramen. In men, an atavistic deformity is found in about one per cent of the population consisting of a bony spur arising on the medial side of the humerus above the elbow and overlying the artery and median nerve. The top of that spur extends into a fibrous wart which attaches to the humerus and completes the encirclement of artery and median nerve. Only very rarely does this deformity give rise to symptoms. In the case described here, a Latin American stenographer developed paraesthesia in the median nerve distribution aggravated by pronation of the forearm. The symptoms subsided on a three weeks regime of short-wave diathermy and no typing.

BIANCHI (8) gives a lengthy review of tennis elbow with description of the condition and all possible and impossible theories that were ever advanced for its etiology. Conservative and surgical treatment were reviewed. A questionnaire was sent out to 204 Italian championship tennis players of which 30 per cent suffered from tennis elbow at one time or another. The treatment consisted in reeducation to a different technique of tennis playing.

REYMOND (9) suggests that for the purpose of treatment, tennis elbow be divided into three groups. In the benign group, wearing of a sling, application of heat and use of novocaine infiltrations over a period of two weeks is advised. In the more severe cases, stellate ganglion blocks, x-ray therapy or the use of some of the European Spas is advised. In the rebellious cases, stripping or resection of the epicondyle is advised. Other surgical methods consist in denervation or drilling of the bone.

Two cases of bony ankylosis of the elbow are described by WEBER and RUTA (10). These cases were treated by wide resection of the joint. One case is illustrated by x-rays only, the other one by photographs also showing full range of motion of the elbow.

Caution is advised by WUSTMANN (11) in attempting to get motion in a stiff elbow for the well known reasons that an elbow arthrodesed in functional position is more desirable than an unstable, painful, and movable one. An attempt at arthroplasty may be indicated in young adults with good motivation, however. The author mentions 11 cases he treated prior to World War II, by arthroplasty (according to Lexer) in cases of bony ankylosis, with fairly good results. A young surgeon during World War II was left with an ankylosed elbow but also with a supracondylar pseudarthrosis following a gunshot wound. He was able to continue surgery, with excellent elbow motion following resection of the head of the radius. Since then the author has performed V-shaped, supracondylar pseudarthroses in 14 ankylosed elbows following gunshot wounds. He covers the supracondylar portion with fascia, and permits a saddle joint to form. He depends on the wedge shape of the pseudarthrosis for lateral stability, and the forearm flexors and triceps extensor for anterior-posterior stability. This gave good functional results without any incidence of later stiffening.

Only one miscellaneous abstract is included. Patella cubiti, according to LEVINE (12), consists of a sesamoid bone located in the triceps tendon, presumably an aberrant sesamoid or a previously separated portion of the olecranon epiphysis. One case is presented. Six cases have been reported previously by three different authors.

The Wrist and Hand

Neurovascular conditions are considered first. FELDER et al (13) evaluate patients operated on since 1929 for Raynaud's Disease or Raynaud's Phenomenon in the Massachusetts General Hospital. 20 patients were studied; 38 had dorsal sympathectomies only and 16 had both lumbar and dorsal sympathectomies. When studied six months to 20 years after operation, clinical recurrence was noted in 64 per cent, laboratory evidence of vasomotor activity was noted in 60 per cent and sudomotor activity in 61 per cent of the 75 upper extremities studied. The results after sympathetic denervation for Raynaud's Phenomenon of the lower extremity are better than the results after operations in the upper extremity. Early recurrences are probably on the basis of anatomic variants which were not sectioned at the time of operation.

LEINWAND et al (14) report two patients in whom Raynaud's Disease and hypertensive vascular disease were associated. One interesting point observed in the case presentations was that in both instances for the first 48 hours following sympathectomy the involved fingers and toes appeared slightly more cyanotic and cold than prior to surgery. However, at the end of one week adequate circulation had again returned to the digits. A good result was reported in both cases.

Raynaud's Disease of the hands with sclerodactyly is a brief and inconclusive case presentation by BRUNSTING (15).

BOULVIN (16) describes brachial block anesthesia and its complications; 25-30 cc's of two per cent solution of novocaine were used without adrenaline. This is considered to be safe from the toxic point of view. The incidence of pleuropulmonary complications is 0.1 to 0.2 per cent. Vascular complications were encountered on the basis of lacerations of the transverse scapula artery of the subclavian vein. Horner's syndrome is described as a complication. (Ed: Production of a Horner's syndrome is certainly a transitory affair and not totally unexpected considering the anatomy of the area; total dose of procaine recommended here is 0.5 gram approximately. One per cent novocaine is equally effective and reduces to a completely satisfactory level the total drug dose.)

The first article considered under neuropathy is one by PHALEN et al (17) who discuss neuropathy of the medial nerve due to compression beneath the transverse carpal ligament. This was first described by Marie and Foix in 1913. Their theory was based on findings at autopsy. The authors describe three cases with four operations. The complaints were bilateral in all cases. The most reliable diagnostic signs were sensory distribution in the hand without atrophy and a Tinel's sign at wrist level. The presenting symptoms were pain, worse at night, but aggravated by exertion during the day, paraesthesia and weakness of grip. Three cases had immediate subjective relief from pain by splitting of the transverse carpal ligament. In two cases enlargement of the nerve proximal to the ligament was encountered.

Only one patient was operated on both sides. (Ed: The cases appear well worked up, were adequately tried on conservative treatment prior to surgery and carefully reevaluated after surgery.

Two more cases of the same condition were treated surgically by BAL-LANTYNE and COMRIE (18). Symptoms and findings consisted of pain, weakness, and numbness in thumb, index, middle finger and volar aspect of forearm occurring when carrying heavy objects, when fatigued, and at night. These cases were bilateral. Treatment consisted of division of the transverse carpal ligament. Exposure of median nerve revealed this structure to be edematous and injected. At followup, patients showed continued relief of pain and improvement in atrophy.

KENDALL (19) presents case histories of 14 patients with median nerve palsy. In eight cases the palsy could be traced to the occupation of the patient. These were all unilateral nerve palsies. In most of these cases the treatment was immobilization in plaster for a few weeks. The author noted that the abductor pollicis brevis is the muscle most affected by the wasting and that six of the eight cases had vasomotor or trophic changes. Six other cases are presented with bilateral nerve involvement. The author notes in comparing the groups that unilateral palsies are seen in the younger age groups and that the bilateral type is seen in the older age groups. The younger group is mainly male and in most cases a particularly strenuous type of occupation is followed with evident trauma to the median nerve at the wrist. On the other hand, the older age group women, develop bilateral palsies as the result of fairly normal activities.

WATSON-JONES (20) writes that the syndrome, pleonosteosis, described by Leri consists of broadening of the thumbs, flexion contracture of the fingers, limitation of motion of the joints, shortness of stature and mongoloid face. Leri was impressed by the bone changes, particularly the large epiphyses of the phalanges. The author describes three members of a family who fall into this group and then another case, who, in addition, suffered from median nerve compression in the carpal tunnel and bilateral Morton's toes. Biopsy of the transverse carpal ligament revealed hypertrophic changes of the ligaments. Release of the carpal ligaments as well as removal of the metatarsal neuromas resulted in symptomatic reliefs. On the basis of the pathological findings, Watson-Jones believes that hypertrophic changes of the ligamentous and capsular structures surrounding the joints is the basic pathology in Leri's pleonosteosis.

ROUNDTREE (21) submitted an article on anomalous innervation of the hand muscles. A number of earlier papers describing anomalous innervation of intrinsic muscles of the hand produced contradictory results. Those early papers were based on anatomical dissection. Following World War II, Murrey, Kirklin and Finlayson analyzed the clinical findings in 398 ulnar and 555 median nerve injuries in regard to innervation of the muscles. After eliminating all unsuitable cases 102 median nerve lesions and 124 ulnar nerve lesions remained. Evaluation was meticulous and based on very rigid criteria. In many instances the good nerve was blocked out with novocaine to gain further information. In essence, it was found that the pattern of ulnar and median nerve innervation as described in the text books is the most commonly found pattern. (Ed: Although it is not specifically stressed by the author, it appears most striking that the opponens of the thumb is innervated by the

ulnar nerve alone in 20 per cent of the cases and supplied dual innervation in an additional 16 per cent. The article represents a very clear, excellently illustrated summary of painstaking study.)

BROOKS (22) advocates bone block for those cases of high nerve lesion where no tendon is available for opponens transplant and for those cases of severe cicatrix of the wrist which would afford too poor a bed for a tendon transplant. The author has a series of 16 cases of which he considers five successful, nine as considerably improved, and two failures. The greatest difficulty lies in maintenance of the correction and avoiding return of the thumb towards its original position of contracture. The author makes the point that full correction of contracture is necessary before attempting bone grafting.

An operation for opponens paralysis of the thumb by HOWELL (23) consists of dividing the flexor pollicis longus tendon at the wrist, rerouting it around the dorsum of the proximal phalanx back to the flexor surface of the wrist, and then repairing it where it was severed.

The sound principles and excellent results of the Warm Springs Foundations are thoroughly analyzed, clearly discussed and superbly illustrated by GOLDNER and IRWIN (24). The material is based on 91 cases. In essence, T. C. Thompson's operation rerouting the sublimis tendon of the ring finger around the flexor carpi ulnaris to the base of proximal phalanx of the thumb has given 85 per cent excellent results in 73 cases. The difficulties arising from weakness of sublimis or flexor carpi ulnaris, other muscle weaknesses of thenar and thumb, instability of MP joint or carpometacarpal joint, or contracture are classified and detailed answers are given. The Foerster-Bunnell bone block is reserved for functionally irreparable hands and used for cosmetic reasons only.

Tendons are considered next and here SILER (25) states that in primary tenorrhaphy of the flexor tendons in the hand emergency treatment consists in control of hemorrhage, treatment of shock, avoidance of further contamination, and when indicated, chemotherapy and anti-tetanus therapy. Operative treatment is carried out under general anesthesia with tourniquet control unless there is a contraindication. All flexor tendons in the palm except those in the vicinity of the metacarpophalangeal joint are repaired immediately. It is thought better to suture the flexor profundus alone or the proximal flexor sublimis to the distal flexor profundus than to attempt approximation of both. Divided nerves require primary neurorrhaphy. The tendon suture method has been that of Mason and Allen, with Bunnell's method being used less frequently. After tenorrhaphy, the wound is closed even if it is necessary to use a skin graft.

HAYS (26) stresses the well-known fact that the repair must be strong, and accurate, and that most important, there must not be an excess of scar tissue. He discusses the formation of scar tissue, nature of the wound, operative technique, infection, and postoperative care. The removable wire technique is preferred with no additions to previously described methods.

Untreated silk is used by FLYNN (27) in flexor tendon grafts in the hand for the proximal anastomosis, catgut for the distal attachment. The four cases described include problems of first magnitude. Some of these re-

quired pedical grafts prior to the tendon transplant. All four cases regained full flexion. Grafts were used only for the index, long and ring fingers. For the thumb and little finger transfer of the fourth sublimis is preferred. A point was made to test the proximal segment and muscle for amplitude and motion. The author considers secondary tendon repair permissible up to two months after injury.

Union is easily obtained in tendon suture, wrote PULVERTAFT (28), especially in the flexor tendons, but a freely gliding tendon is difficult to obtain. In the finger the author uses delayed free grafts, whenever both sublimis and profundus are cut. If only the profundus is cut and a good sublimis remains, the sublimis is not disturbed; rather a thin extensor tendon of the toe is used to replace the profundus. In the thumb he uses either immediate or delayed tendon suture. If neither is practical a free graft elongation of the flexor pollicis longus, or a flexor sublimis unit may be used. On all free tendon grafts he uses a toe extensor with its paratenon. No splinting is used, except in children, postoperatively. Full evaluation of results cannot be made until nine to 12 months postoperatively. In combined nerve and tendon injuries at the wrist the trend now is to suture the tendons immediately and the nerves three to four weeks later.

ISELIN and LAFAYRY (29) in seeking a way to circumvent the difficulties in tendon repairs in "no-man's land," conceived the idea that since tendons need immobilization for healing, and since mobilization remained the key to preservation of function, that the logical conclusion would be to split the procedure into two operations: healing of the tendon, then tenolysis with immediate mobilization. The clinical results of this concept were disappointing, but it permitted the basis for a fundamental study, both from the point of view of gross pathology and histology. It was noted at the first stage of the delayed repair that all the tendons showed degeneration from the point of severance proximally to the muscle itself. This was manifested by a globular formation at the severed end, by yellowish discoloration of the tendon, and by a high degree of friability which permitted rupture of the tendon without significant force. Histological analysis showed that the degenerated tendons lost all their nuclei, the parallel arrangement of the fibers was disturbed, and the interspaces between tendon and paratenon obliterated. Extensive vacuolization throughout the tendon was noted. At the second stage, tenolysis, it was found that the healing was much better and stronger if steel wires were used and that the healing was poor and surrounded with granulomatous tissue when silk was used. The entire length of the tendon formed cicatrix. After freeing, the tendons frequently became stuck again. The authors then removed the entire length of the severed tendon out to the distal phalanx and replaced it with delicate woven steel cables. It still was not gratifying. The steel cables always broke at the level of the MP joint, and though repair of the broken cable was not too difficult, it was noted that it had surrounded itself by a structure very similar in appearance grossly and histologically to a degenerated tendon. This in time formed dense adhesions.

THATCHER (30) describes the use of facia lata strips for replacement of injured flexor tendons in the hand when more than one finger is to be reconstructed or in congenital absence of the palmaris longus tendon. The operation is done in two stages. In the first stage, the injured tendons are removed and tendon sheaths canalized with stainless steel rods. In the sec-

ond stage the fascial strips are transplanted into the newly formed tendon sheaths. The author re-emphasized that in the palm the sublimis and profundus tendons must be severed well proximal to any adhesions in order to minimize postoperative adhesion formation. No statistics are quoted. The author has used this operation for the past ten years with good results.

ROUHIER (31) describes an operation for repair of the tendon of the long flexor muscle of the thumb which permits retention of the original tendon since this tendon is superior in strength and shape to the flat and narrow tendons of the toe muscles. To avoid complicating infection, the operation is done after the wound of the thumb has healed completely. The proximal tendon fragment is lengthened and advanced to span the site of the interruption. The area of Z-lengthening is reinforced with the distal tendon segment.

A series of 138 grafts to the fingers performed on 118 patients are analyzed by BOYES (32) based on the follow-up study of 104 cases. The area discussed extends from the distal palmar crease to the flexion creases of the proximal IP joints. The most significant factor influencing the results rested with the postoperative condition of the fingers. In the favorable cases, 10 per cent perfect results were obtained and 90 per cent of the cases could flex the finger tip to within one inch of the palm. In cases with considerable cicatrix no perfect results were obtained and only 25 per cent of the patients could bring their finger tip to within one inch of the palm. Stainless steel sutures were found significantly superior to the use of silk. Most of the failures occurred in cases in which silk was used. The palmaris tendon was preferable to the sublimis tendon as a source of graft. The author advised excision of the tendon sheath and pulleys wherever they were scarred. Of the 104 cases, there were 10 failures, 10 further cases required secondary surgery. Tendon grafts for the thumb were carried out in 23 cases. It was found better to extend the graft from the finger tip to the forearm, rather than to use a shorter graft from the finger tip to the thenar eminence.

Stenosing tenovaginitis involving the abductor pollicis longus and extensor pollicis brevis tendon sheaths at the level of the radial styloid was described by De Quervain in 1895. HALL and BERG (33) report 22 cases. Symptoms were typical pain of gradual onset, localized over the radial styloid. Grasping and lifting were painful. Conservative treatment by splinting relieves the patient but frequently takes four months to two years. Surgery gives prompt relief with less economic loss. Under local anesthesia a transverse incision is made, and the small sensory branch of the radial nerve is isolated. The tendon sheath is split longitudinally to permit full release of the constriction. Early motion is encouraged and normal use urged as soon as skin sutures are removed. In 22 cases, complete relief was secured in two to six weeks.

GUERIN (34) distinguishes three conditions: crepitating tenosynovitis, stenosing tenosynovitis, and trigger finger. The well known entity of trigger finger and De Quervain's stenosing tenosynovitis are described and respond to surgery. The crepitating tenosynovitis, however, affects primarily the extensor tendons in athletes like basketball players and responds well to immobilization in plaster of Paris for a brief period of time.

15 cases with calcific deposits about the hand and wrist (flexor carpi ulnaris at the pisiform bone; flexor carpi radialis at the greater multangular and about the palmar aspect of the heads) are presented by SEIDENSTEIN (35). The findings were severe pain and induration of the area of the deposits; frequently they have been diagnosed as an infection until x-ray examination was done. The symptoms may be relieved by: Plaster cast and procaine infiltration. Surgery is not necessary. The condition is a self limiting one and within three weeks the deposits fragment and disappear. There is no clue as to etiology.

KASTERT (36) feels that in the usual operation for wrist drop with transplantation of the flexor carpi ulnaris or flexor carpi radialis, about one-half the strength of the muscle is wasted in a useless lateral pull. He feels that this is the reason for poor results. He suggests the flexor carpi ulnaris be threaded through the extensor digitorum communis and extensor pollicis longus while the flexor carpi radialis be threaded through the abductor pollicis longus, extensor pollicis brevis, and extensor carpi radialis longus. The ends of the transplanted flexor carpi radialis and ulnaris are then anastomosed to each other. In this way, approximately all of the combined muscular pull is exerted in a useful proximal direction.

The first of three articles on wrist joint is one in which a method of arthrodesis of the wrist is presented by THOMAS (37). The medial surface of the distal end of the tibia was suggested as a donor site for a diamond shaped bone graft for wrist fusion. The advantage is thought to be in the curve of the graft which permits a cock-up position of the wrist without crowding the overlying tendons. The article describes the method alone, no cases are presented.

A case of dorsal dislocation of the distal end of the ulna was treated by fusion of the distal radio-ulnar joint and resection of part of the shaft of the ulna proximal to the fusion by VERGOZ (38).

RUSSELL (39) reviews 59 cases including a comprehensive discussion of every injury to the wrist. In recurrent subluxation of the navicular, the best results are obtained by closed reduction followed by mobilization exercises. Excision of fragments offer no advantage. Bone grafting of the navicular gave disappointing results. The persistence of x-ray pathology, non-union, aseptic necrosis or even un-reducible deformity does not preclude a good functional result. The ultimate result appears dependent on the time the injury is treated. Median nerve paraesthesia is the outstanding sign of dislocation of the lunate.

Carpal lunate section includes an article in which DORNAN (40) discusses Kienboeck's disease. This author reviews his experience with 43 cases which were observed over a ten year period. He does not confirm the theory of ulnar shortening. 63 per cent were treated by excision of the lunate except one which received an arthrodesis. The rest were treated by immobilization for a period of three to four months. The author concludes that results of conservative and surgical treatments were very similar.

JAMES (41) reports a case of rupture of flexor tendons secondary to Keinboeck's disease. A 50 year old truck driver had a nine year history of wrist pain. Four months prior to hospitalization he noticed loss of active

flexion in the distal joint of his index finger. Three months later his hand suddenly became cramped and when the cramp subsided, the flexor function of the interphalangeal joint of the thumb was gone. Exploration of the carpal canal revealed ruptures of both tendons and a perforation of the anterior capsule of the joint overlying the lunate through which six small loose bodies extruded. Tendon function was successfully restored by reconstructive surgery.

A case of bilateral Kienboeck's disease was reported by SOBEL and SOBEL (42) and has been reported in only six other instances. This author's case was a 43 year old woman who had discomfort for six months without trauma. The x-rays revealed areas of radiolucency in both lunates. There was no collapse of either lunate. (Ed: All that can be said with certainty about this case is that bilateral lesions of the lunate are present. It is felt that further chemical and skeletal studies would have been of interest and that this may not necessarily represent true Kienboeck's disease.)

LIPPMAN (43) makes a preliminary report of replacement of an excised lunate by a hollow vitallium replica. The patient was followed for 79 days postoperatively. At that time, he had returned to his occupation as a plasterer. The pain had been relieved three days after surgery but his wrist remained slightly enlarged and the forearm somewhat atrophic.

Lunates and perilunate dislocations, states ANNERSTEN (44), are the most common of the carpal dislocations, and are produced by a forcible dorsiflexion and a powerful thrust on the extended palm. They are usually associated with fracture of the navicular or the styloid of the radius. Of seven cases, only one was successfully treated by closed reduction. In recent cases open reduction was easy and the results are good. The author placed the cases in slight volar flexion for one week as dorsiflexion or neutral position caused the lunate to slip out of position. The fracture of the navicular when present does delay healing and the author felt that the association of the dislocated lunate had a bad effect on the healing navicular. He believes that open reduction is the method of choice and that a delay of even five weeks has no effect on the end result.

Under carpal scaphoid is an article in which WAUGH and SULLIVAN (45) write that among anomalies of the carpus the bipartite navicular is the most common. Gruber in 1865 described four bipartite naviculars in a review of 3002 carpal scaphoids. The author describes two cases of bipartite navicular which occurred bilaterally. (Ed: There is no good reason listed in the article why these roentgenograms should not be called non-union of the navicular except for the fact that the x-rays were read by Dr. Albert D. Ferguson of Boston and that his precise and sharp analysis of the findings lends that questionable entity considerable weight.)

DWYER (46) alleges that considerable progress has been made with non-union of the carpal scaphoid. Age, presence of arthritis, and associated subluxation of the lunate were considered as factors influencing the outcome of the 19 cases. 12 were good, 4 were fair, and 3 were bad. "Trial excision" is recommended since it can be followed by arthrodesis if unsuccessful. Excision of the proximal pole alone is considered inferior to total excision.

HAGEN (47) describes one case of dislocation of the scaphoid and reviews the literature. The first case of that nature was described by Ewing in 1921. A total of five cases has been reported since. All those previous cases healed with poor results and reduction was not possible in most of them. The author's case was a compound injury resulting from a fall. The navicular was displaced anteriorly and x-rays revealed a separation from the lunate. The dislocation was reduced under local anesthesia ten days after injury and immobilized in a cast for four weeks. Subsequently, full function of the hand was obtained.

A case of recurrent subluxation of the scaphoid is reported by VAUGHAN and JACKSON (48). The condition developed in an athlete following a sprain. It was characterized by local pain on flexion of the wrist and by an audible click upon rapid dorsiflexion. X-rays taken at rest were unrevealing. The patient, however, was able to voluntarily maintain the subluxation and then the most striking feature was a wide separation between the navicular and lunate. He was able to control his condition so well that he did not feel that there was any need for further therapy.

DESSE and MINET (49) report a case of osteolysis of carpal scaphoid. Ramazzini in 1767 first described swollen wrists occurring in bakers who had been in their profession for a long time. The author further quotes Gruber who in 1865 described bipartite naviculars allegedly resulting from separate ossification centers and Dupuytren who found arthritic changes in workers on printing presses, diamond cutters, pharmacists (from rolling pills), harpists and violin-cellists. He finally quotes Volkmer, who referred a baker with sore wrists to Dr. Osgood. He had a bipartite navicular but this was blamed on a gonorrhreal infection. The author's case is a 49 year old baker, who had been in the profession for 38 years and noticed progressive difficulty with his wrists for the past five to six years. The x-ray appearance was one of non-union and the author calls it bipartite scaphoid without any other positive proof except the absence of known trauma. He then studied another 19 bakers who had been in the profession for a long time and found one more unilateral non-union of the scaphoid, but some degree of arthritic alterations in all the other cases.

CAFFARATTI (50) reports a case of congenital bilateral bipartite carpal scaphoid.

AVENIER (51) describes all the methods of treatment for non-union of the navicular which he had abandoned.

Carpal-metacarpal joints are represented by five articles. Osteoarthritis of the trapezio-metacarpal joint is discussed by LASSEUR et al (52). The best x-ray view of the trapezio-metacarpal joint is obtained by having the patient kneel next to the x-ray table. The forearm and hand are then placed in maximal pronation so that the snuff box comes to rest on the film. The changes of osteoarthritis are described. The painful joint should be immediately immobilized to prevent further development of arthritis. For this, an illustration of a well-fitting splint is included.

A method of reinforcement of the first carpo-metacarpal joint by passing the fascia lata through drill holes is described by MICHELE et al (53). The method is recommended for traumatic luxation, malunited Bennett's frac-

ture and osteoarthritis with subluxation. Three cases with short preoperative history of local complaints and no serious attempt at conservative management by immobilization were relieved by this procedure.

Excision of the trapezium for osteoarthritis of the trapezio-metacarpal joint was carried out 18 times on 15 patients by GERVIS (54). The technique of operation is meticulously described. The results were uniformly excellent and gave complete relief of symptoms with a surprising degree of stability of the thumb in all but two cases in which there was generalized involvement of the hand. The author prefers excision to arthrodesis, stating that arthrodesis is difficult to obtain.

MULLER (55) prefers arthrodesis to excision. He claims that you can excise the bone only once, but in fusion, you can repeat the procedure if it has not turned out satisfactorily. The operative technique appears much simpler than excision of the bone. A simple inlay graft is used and the thumb immobilized in a cast for four months. In eight cases perfect fusion was obtained. The patients were relieved from pain, regained a very strong grip and an excellent range of motion which is illustrated by convincing photographs.

A case with dorsal dislocation of the second, third, and fourth metacarpals and volar dislocation of the fifth metacarpal is described by GIRAUD and VITTORI (56). It was noted that the motor branch of the ulnar nerve was not affected.

The Hand and Fingers

The first article abstracted under infections of the hand and fingers is one concerning infection of the flexor tendon sheaths of the hand treated previous to the days of antibiotics and 50 cases since the advent of antibiotics presented by FLYNN (57). He points out that acute suppurative tenosynovitis is decreasing in frequency. There has been in recent years a further decrease in the incidence of suppurative tenosynovitis. In 1943 12 cases were seen in the Boston City Hospital. In 1948 only six cases were seen. With antibiotics as an adjunct to surgery the number of good results has been more than doubled and the number of poor results is about one-third of what it was before the use of antibiotics. Puncture wounds have been found to be the most common type of injury causing septic tenosynovitis. The primary site of infection in 50 per cent of the cases was the transverse volar crease where anatomically the tendon sheath is devoid of its fibrous layer. Blind irrigation may cause extension of the infection. The author advocates adequate incision and drainage of all recesses of the infection together with parenteral administration of penicillin.

A series of 50 unselected cases of pulp space infection was compiled in 1947 by BOLTON et al (58). All cases were operated and pus was found in each instance. The procedure of choice was a small elliptical skin excision accurately overlying the abscess. The cases were grouped into simple felonies, 39 cases, which had an average healing time of 11 to 15 days, five cases where bone involvement was suspected but could not be proved, with average healing period of 25 days; and six cases of verified bone infection with average healing period of 35 days. Penicillin was used locally in three cases of osteomyelitis intramuscularly but not in an attempt at non-surgical man-

agement. (Ed: Efficacy of the antibiotics was apparently not high enough at that time to encourage non-surgical management.)

SAMUEL (59) claims transillumination of the finger tip to be a valuable adjunct to the diagnosis of infection. Pus, as well as tissue slough, throws a definite shadow. This is considered helpful in deciding when and where to incise in acute infection. Chronic infection and paronychia are described. In order to get accurate information it is necessary to thoroughly cleanse the hands.

Hand surgery in general is considered next. In a comparative study of silk and steel sutures in repairing dog tendons the steel sutures were found superior by CARON (60) who states that they caused less inflammatory reaction and thus a more uniform scar capable of greater tension. However, steel suture material has a tendency to cut the tendon tissue and this disadvantage was overcome by using a very fine caliber wire. (Ed: Fine braided wire has greater tensile strength and less tendency to cut through.)

MEYER (61) has altered the Allen and Mason universal aluminum splint described in 1947 by making a wooden mold of the Allen-Mason splint and using plaster of Paris, thus permitting greater variation in the extent of individual finger immobilization.

JENKINS (62) advocates the adhesive strapping of a recently sprained or dislocated finger to the adjacent uninjured finger. In so doing, one has an effective splint and if strapping is applied loosely, motion is possible and stiffness is avoided. The method may also be applied to stable fractures of the phalanges and metacarpals.

BERNHARD (63) points out the important fact which is not considered by all who treat finger injuries, that although the injury appears small, the disability to the proximal IP joint sometimes persists for a long time. The author mentions six case histories in which this was so. One was a minor sprain with slight discomfort remaining after 14 years. A similar disability resulted from cases of fractures of the proximal end of the proximal phalanx. Adequate splinting in the physiological position followed by active, and not passive, motion is recommended.

Functional position and spring assisted functional motion is stressed by BUNNELL and HOWARD (64) along with the resistive exercise. The reader is referred to the excellently illustrated article for detailed description of these modifications of the time honored "knuckle-bender" splint.

TUCKER (65) emphasizes early, gentle, active exercises without strain in treatment of traumatic conditions of the fingers, hand and wrist. Every effort is made to disperse traumatic effusion; e.g. elevation, contrast baths, faradic stimulation of muscles, aspiration or incision where indicated. Specific injuries are described and discussed.

BUNNELL (66) presents a paper designated for the occupational therapist, reviewing functional anatomy of the hand, splinting, specific functional problems, as well as psychological applications. All reconstructive surgery should be completed prior to institution of occupational therapy. This is an excellent review for the orthopedic surgeon prescribing occupational therapy.

KESTLER (67) has had considerable experience in reconstruction of hands crippled by rheumatoid arthritis. His approach is conservative, the cases are extremely well worked up. 11 cases of resection of metacarpal heads were followed over a period up to four years, eight months. A portion of the surgical success was ascribed to shortening of bony elements and preservation of the articular portion of metacarpals with placement of these over shortened shafts.

BUFF (68) discusses the principles of hand surgery dealing with evaluation of each digit and its importance; the principles governing the suturing of tendons, nerves and skin in the hand and with the general technique and peculiarities about hand surgery. The author apparently is the Bunnell of Switzerland and in his bibliography only Bunnell and he himself are mentioned. There is nothing in it that could not be found in Bunnell's text.

LIEBOLT (69) states that the collateral ligament of the MP joint is tense in all positions of the joint while it is commonly accepted that the ligaments are relaxed in extension and tense in flexion. Apart from this, the technique of capsulectomy is the one described by Bunnell. This operation has been performed by the author in 11 cases gaining 30 to 90 degrees of additional flexion as a result. An important point is made--that of the motion gained at surgery, about 20 degrees is usually lost again. Two cases of arthroplasty are presented; one by resection of the metacarpal head, with full return of motion and another case with resection of the base of the phalanx with improvement of motion.

RUBIN et al (70) deal with scar contraction along the flexion creases. Breaking up of the scar line is accomplished by Z-plasty or variations thereof. The work was done at Kings County Hospital in Brooklyn and includes excellent illustrations.

BRUNER (71) advocates the use of an old fashioned buttonhook for fracture reduction in hand surgery.

Observation of strict plastic principles, preservation of digital length, and adequate coverage of functional elements have been stressed in skin plastic procedures. STENBERG (72) favors full thickness grafts as replacement for amputated fingertips. The importance of maintaining compression for at least three weeks is emphasized. In 29 out of 37 cases, there were 100 per cent takes, in seven cases there were 75 per cent takes or better, with still excellent functional results and only one case was a failure due to infection.

Transdigital flaps, according to GURDIN and PANGMAN (73), similar to cross-leg flaps, have been used in cases where bone or tendon is exposed, where adjacent fingers are not injured and when the defect is not too extensive for adequate skin to be obtained from a donor finger. Plastic principles must be adhered to with emphasis on avoiding crossing flexion creases. The donor defect is covered primarily by a split skin graft. Pedicles have been severed between the 14 and 21st days. No flap has been lost in six cases reported.

The interdependence of satisfactory skin coverage and repair of structures, sensory, and motor elements, is stressed by MACOMBER (74). Free grafts

must not be used as final cover over tendons or joints not protected by a gliding mechanism. Specific indications for uses of free grafts, pedical grafts and flap shifts are listed.

FUCHS (75) reports that in 14 of 54 patients recently subjected to plastic surgery, skin transplantation for prophylactic purpose was done immediately or within a month after trauma. All variations in degree and extent of burns were represented in this material. Postoperative contractures included five of the shoulder. Z-plasty was done either alone or in combination with other treatment in 28 of the 42 cases.

Under reconstruction of digits, a case of thumb reconstruction by transfer of the big toe was reported by CLARKSON and FURLONG (76) in a girl who at the age of three years lost all but the proximal phalanges of her fingers and the thumb. At the age of nine the big toes of the same side were grafted onto the first metacarpal. As preliminary operation a flap with distal pedicle was raised on the foot. After the actual transfer, the hand remained sutured to the foot for six weeks. After two weeks the medial nerve vessel bundle of the toes were severed, at four weeks the lateral bundle, and at six weeks the full transfer was completed. The patient suffered no ill effect from the removal of the toe and continued her participation in sports. The thumb remained viable but further surgery consisting of the attachment of the flexor tendon and anastomosis of the nerves and a bone graft to obtain union in the junction of the bones is still contemplated.

A case of substitution of fingers is reported by ROSENSTEIN (77). The patient was a pianist who lost her long finger. The cicatrix incident to that loss prevented her from playing octaves. The second toe was substituted for the long finger in two stages. Bones, tendons and nerves were joined and apparent function resulted. The degree of function is not specified except that the pianist will return to her occupation and play octaves.

GRAHAM et al (78) present a method of restoring grasp and pinch after the loss of all digits. A hand without digits has lost its three major functions: grasp, pinch and hook. A prosthesis never functions as well as a hand with sensation. If the ability to pinch or grasp can be restored between two opposable areas which have sensation, then a great portion of the hand function will be preserved. Their method consists of digitization of the first metacarpal bone, since the first metacarpal phalangeal joint is the only one with appreciable circumduction motion. Two essentials for useful digitized first metacarpals are: adequate depth of the cleft and adequate length to the movable portion. The second metacarpal is used for increasing the length of the first metacarpal. The long flexor of the thumb should be attached to the first metacarpal. The interosseous muscles between the first metacarpal and third metacarpal should be utilized to increase the pinch strength of the digitized metacarpals. Five cases illustrating this method are presented. The method is especially useful in individuals who have poor eye sight since the use of a prosthesis for a partially blind individual is a great handicap. They state that a better functional result can be obtained by this method than with available prostheses.

D'AUBIGNE et al (79) report that in three cases the missing thumb was substituted by the remainders of an also injured index. In another five cases a new thumb was built by abdominal pedicle carrying an iliac bone graft

along with it.

HUGHES and MOORE (80) give a preliminary report on the use of a local flap and peg bone graft for lengthening a short thumb. Their two patients had sustained traumatic amputation of the left thumb at the metacarpophalangeal joint. A cap of normal skin over the amputation stump of the thumb was retained in both. The entire flap was undermined and raised from the metacarpal bone. Next, a block of bone with periosteum attached cut from the iliac crest and shaped to resemble a metacarpal, was firmly impacted into the metacarpal bone of the thumb. The skin flap was transferred over the bone graft and split thickness graft was sutured in place over the raw area.

MITHOEFER (81) discusses injuries limiting the mobility of the thumb and states that the mobility of the thumb depends on three factors: (a) the integrity and liberty of action of its musculotendinous apparatus, (b) the proper alignment of its bones and the mobility of its joints, and (c) the redundancy and elasticity of the skin and subcutaneous tissue of the thumb's web space. The article includes five case reports illustrating loss of thumb function resulting from fractures with healing in poor position, injuries to muscles related to the thumb with their tendons, and soft tissue injuries resulting in contracture of the web of the thumb. The article discusses methods for relief, and improvement of these conditions. Surgical principles stated are standard surgical principles.

HOWARD (82) outlines the treatment of contracture of the thumb web. The fundamental hinge to hinge principle is established. Skin replacement after release of contracture has to straddle the web from the dorsal aspect of the carpometacarpal joint to its volar aspect. This is convincingly illustrated by a variety of excellent reconstructive results.

An interesting anthropological study by HARRIS and JOSEPH (83) measures the variation in extension of the metacarpophalangeal and interphalangeal joint of the thumb in 132 white males and 100 white females, 31 Indian males, and 30 West African males. Slight differences between the males and females as well as right and left side were established. An inverse ratio between the MP and the IP joint was found. Influence of musculature, capsule and bony structure on the range of motion is discussed.

Dupuytren's contracture: Recent suggestions for the treatment of fibrosis of the palmar aponeurosis include the shifting of a dorsal pedicle flap and the use of vitamin E. None of the authors point out the occasional occurrence of a similar process in the feet of afflicted individuals. The loss of flaps and skin coverage continues to be troublesome.

BRUNER (84) recommended the use of a dorsal skin flap for the coverage of palmar defects after aponeurectomy for Dupuytren's contracture. In advanced cases, subcutaneous fat is displaced and even skin may be invaded by the proliferating palmar fascia resulting in loss of skin at the time of excision. Skin shrinkage after prolonged flexion contributes to the problem of adequate skin coverage. The author advocates the shifting of a dorsal pedicle flap in such cases. The mid-lateral line of the ulnar border of the hand forms one side of the triangular flap; the apex of the flap lies proximal to the middle joint of the fifth finger. The donor defect is covered primarily with split skin. Careful plastic principles must be employed.

A series of 13 cases comprising 22 hands treated with vitamin E for Dupuytren's contractures is analyzed by THOMSON (85). The review of the literature reveals divided enthusiasm, an equal number pro and con. The therapy consists in daily administration of 300 milligrams of mixed vitamin E or 200 milligrams of ephynal. Perhaps vitamin E therapy will prove efficacious in early cases and in preventing postoperative recurrence. Earlier work disputes its use in advanced cases.

GRAY and DE TARNOWSKY (86) quote extensively from Bunnell regarding the diagnosis, pathogenesis and pathology of Dupuytren's contracture. Their experience in two patients (total of three hands) is described in detail. In each of the three cases, some slough of skin appeared postoperatively beneath a hematoma. This occurrence points to the need for hemostasis and pressure dressings in the management of this condition.

RUMMELHARDT (87) reviews the etiology, pathology, and describes the excision through longitudinal incisions of Dupuytren's contracture. Recurrences appeared in 25 per cent. The work of Thomanek, who used radium therapy, is referred to.

50 operative cases were reported by WENZL (88) with 74 per cent regaining full function, 16 per cent good results, and 10 per cent bad results. Nothing new in technique is offered.

In a discourse on Dupuytren's disease PAILLOT (89), aside from giving the generally known pathology, describes subluxation of the IP joints in advanced cases, as well as sclerosis and shortening of the digital blood vessels. In addition to current and past pathogenic theories where emphasis is placed on its occurrence in various diseases of the spinal cord, Lerich's and Young's theory of connection with parathyroid dysfunction is mentioned. The treatment is divided into conservative and surgical. Of interest is the emphasis on stellate ganglion blocks and the inclusion of sympathectomy or parathyroidectomy amongst the conservative approaches. The author is reservedly satisfied with the results of early surgery for Dupuytren's disease but feels that disability has to be accepted in late cases. (Ed: He practices in one of the European Spas, where many terminal stages of arthritic deformities are concentrated. It is obvious that he deals with a number of very severe terminal phases that are not commonly seen in our practice.)

Under miscellaneous are grouped ten articles. Cyst-like changes in the small bones of the hand are described by OOSTHUIZEN (90). He lists 17 of the most common causes as follows: (a) chronic gout, (b) tuberculosis, (c) Boeck's sarcoid, (d) chondroma, (e) implantation dermoid, (f) glomus tumour, (g) secondary deposits, carcinomatous and melanomatous, (h) blastomycosis, (i) yaws, (j) hydatid disease, (k) compressed air drill disease, (l) osteoarthritis, (m) osteitis fibrosa cystica localisata, (n) bone cysts, (o) polystotic fibrous dysplasia, (p) injury to cancellous bone, (q) occasionally hyperparathyroidism and neurofibromatosis. No conclusions were drawn.

A case of hamartoma of the hand was reported by COVENTRY et al (91). Hamartoma was described by Albrecht in 1904. It is a name for a tumor-like malformation of congenital origin. It is not considered a true neoplasm. In most instances this condition has been found or claimed to be found in

lungs, liver, kidneys, or spleen. The case described here is the one of a 69 year old woman with a three year history of tumor extending into the palm. The encapsulated tumor originated between the 3rd and 4th metacarpals and was delivered through a palmar incision. It contained various connective tissue elements including precartilaginous and cartilaginous tissue and meta-plastic bone.

Lipomas of the palm are exceedingly rare with only 11 reported to the date of this paper. BOSCH and BERNHARD (92) present the second recorded case in a negro. The patient presented herself with the complaint of a painless, progressively enlarging swelling of the palm interfering with the function of the fingers. At operation an encapsulated lipoma was found attached to the sheath of the flexor pollicis longus. Pathological diagnosis was lipoma.

FRANCON (93) discusses the hand in gout. He states that gout usually starts with the big toe and finally reaches the upper extremities after 10-15 years. He describes acute and chronic forms. Nine out of 26 cases were associated with Dupuytren's contracture and in the late stages, lesions of nails, eczema, psoriasis and x-ray changes were noted.

JOLY (94) discusses the hand in chronic inflammatory rheumatism. The French term of polyarthritis, chronic, progressive, of Charcot appears to be a synonym for our rheumatoid arthritis. A very vivid description of clinical and pathological manifestation during the phases of development and full establishment of the disease is given. No new suggestions for therapy are given.

SORREL (95) reports a condition resembling Volkmann's contracture of the hand as the result of extensive osteomyelitis in childhood, binding down the flexor tendons. The fingers could be extended with the wrist flexed, but in forced extension of the wrist the MP joints could not be extended. The author planned to correct the condition under anesthesia. To his surprise, he found that anesthesia completely relieved the condition. He speculates that reflex muscle spasm may have been one of the etiological factors operative in establishing the contracture.

FELSENSTEIN (96) reports a case of a 17 year old girl diagnosed as chronic nephritis because of severe hypertension, enlargement of the heart and microscopic hematuria. Flexion contractures of her fingers, which had developed during the past six months, were considered to be on a preuremic basis.

DESSE (97) reports a case of Thiermann's disease. The patient had painful swelling of fingers aggravated by rain and cold. The affected proximal IP joints presented a bony deformity. The proximal phalanx formed a male wedge received by a corresponding female notch at the proximal end of the middle phalanx. In this case the condition was associated with intracranial pressure and hydrocephalus.

KONAR (98) presents a case of dystrophia myotonica with a failure to relax the grip after a handshake. The case presented had cramps in the hand, inability to relax the grip and peculiar spasm of certain muscle groups, the deltoids, biceps, triceps, and quadriceps. There was simultaneous contraction of the flexors and extensors of the arms and the thighs. In addition

there was loss of hair of the head, face, axilla and pubis, and impotence. The patient was treated with quinine sulphate and experienced considerable relief of the myotonus and the involuntary spasms. He left the hospital before the effect of the prostigmine could be evaluated.

CURTIS and KIRKMAN (99) compiled for dentists and oral surgeons a 67 page treatise illustrated by 59 excellent photographs covering the entire dermatology of hands and nails including infection, fungi, neoplasms, and radiodermatitis.

Two cases of habitual locking of a metacarpophalangeal joint by a collateral ligament are reported by LANGESKIOLD (100). Heretofore, the cause of a "trigger finger" has been variously attributed to incongruity of the articular surface and hourglass deformity of a flexor tendon sheath. The author, in the present communications, adds a new concept of the mechanism of a snapping finger. In both of the cases reported by the writer, it was found that the radiovolar collateral ligament of the metacarpophalangeal joint of the index finger had been luxated and caught on the abnormally developed capitulum of the second metacarpal bone. Trauma and focal infection (tonsillitis) were considered as contributory causes of the bony abnormality. Both patients had been subjected to exploratory arthrotomy, the respective lesions had been corrected and the trigger phenomenon had been abolished. The author states that a perusal of the available literature failed to show similar case reports. Interestingly, the author's second patient had to have his collateral ligament severed because it had projected itself into the joint and hitched onto the volar metacarpal articulation with the production of locking and snapping. Recurrence has not been noted in these two cases.

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CHAPTER XVIII

AMPUTATIONS AND PROSTHESES

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I. Indications and choice of procedure

- A. General
- B. Refrigeration
- C. Gangrene
- D. Choice
- E. Effects

II. Techniques

- A. Shoulder girdle
- B. Hemipelvectomy
- C. Cineplasty
- D. Krukenberg

III. Complications

- A. Pain
- B. Scars
- C. Phantom limb

IV. Construction and fitting

- A. Fitting
- B. Construction
- C. Suction sockets
- D. General

V. After care

- A. Rehabilitation
- B. Nursing care
- C. Amputations in Malaya and Israeli

There were 130 articles relating to amputations that appeared in the world literature in 1950 and 78 were selected for review.

Indications and Choice of Procedure

In general consideration, EPSTEIN (1) reviews the history of a group of American leg amputees before 1900. Some of these amputees are forgotten but some became celebrities. The surgery was crude and most of them either used crutches or wore a peg leg.

SCHULTZ (2) studied 100 consecutive amputees at Bellevue Hospital and found that two-thirds of the amputees were males, approximately 75 per cent

of lower extremity amputations were due to peripheral vascular disease, 50 per cent were unilateral above knee amputations and 25 per cent were unilateral below knee. Half of the patients were believed unsatisfactory for prosthetic fitting but many very elderly patients were trained in the satisfactory use of prostheses. The average age was 59 years (22 to 83).

WERTHEIMER et al (3) applied refrigeration to 60 cases which had arthritis and gangrene of the extremities. In 23 cases anesthesia was sufficient for amputation, in 37 additional anesthesia was needed. Wound healing was normal. The refrigeration had a bacteriostatic effect and allowed the postponing of the amputation until the patient's general condition had improved.

VOLPE (4) reports on refrigeration anesthesia in 14 cases of amputations of the limbs. He claims that three hours of refrigeration was sufficient. An excellent effect on the postoperative course and the healing of the wound was noted.

SPRENGELL (5) also reports that refrigeration is an ideal anesthesia for amputation in gangrenous limbs.

LARGE (6) using refrigeration studied wound healing and spread of infection in dogs. He found: (a) prolonged cooling delays wound healing, the degree of healing being roughly proportional to the duration of the cooling period, (b) the resistance of tissues to bacterial invasion decreases after cooling, (c) the incidence of infection in wounds treated by delayed primary suture increases by refrigeration, and (d) nerve degeneration follows prolonged cooling of an extremity.

SILBERT and HAIMOVICI (7) report on a series of 213 midleg amputations performed for gangrene. Primary closure was used in 67 cases. Of 50 patients with diabetic gangrene treated in this manner, 36 healed by primary union and 14 had a narrow area of gangrene along a small part of the suture line. In the nondiabetic group, primary healing was recorded in 11 out of 17 patients. In the entire series, reamputation above the knee for gangrene of the stump was necessary in eight cases, and for contracture of the knee joint in two cases. The use of a tourniquet was thought to be responsible for three of these failures. The authors regard the following as indications for midleg amputation: (a) cases in which transmetatarsal amputation of one or all the toes has failed, with necrosis spreading toward the ankle, (b) cases with gangrene of several toes extending to or beyond the adjacent metatarsal regions and showing no tendency to demarcate, (c) cases with spreading gangrene of the heel or above the ankle, and (d) cases with spreading gangrene of several toes associated with uncontrollable infection of the foot. There are three major contraindications to below the knee amputations: (a) extensive gangrene and infection of the leg with absence of the femoral pulse at the groin, (b) gangrene of the foot associated with flexion contraction of the knee joint, and (c) recent thrombosis of the femoral artery.

McLAUGHLIN and WIEDMAN (8) review the surgical management of infection and gangrene in the diabetic extremity over a 17 year period, 1932-1949. In those seen between 1932-1942, there were 53 patients with infection or gangrene of the lower extremities, an incidence of 6.6 per cent of diabetic admission. In the past seven years 43 additional patients were treated, representing an incidence of 6.8 per cent. The hospital mortality in the two

series of cases was reduced from 22.6 per cent to 16.2 per cent by: (a) earlier decision on a major amputation, and (b) antibiotic therapy.

SMITH (9) reports the results of studies of 95 patients with amputations for thrombo-angiitis obliterans and arteriosclerosis. The presence of the popliteal pulse before operation is an indication of success of the below knee stump, but its absence does not exclude a below knee amputation. Tests for the vascularity of the part should be made both before and during amputation.

WEINER (10) reports a case with meningococcaemia and meningitis complicated by gangrene of the foot which later required amputation. 11 similar cases have been previously reported, nine since 1944. The probable pathogenesis of the condition is discussed with consideration given to such factors as meningococcaemia, shock, adrenal insufficiency, arterial spasm, and sludging of blood.

SZABOLICS and BIKFALVI (11) report 10 cases of arterial embolism as a cause for amputation. The obstruction was situated in the common iliac artery in one, in the femoral artery in four, in the popliteal artery in three, in the axillary artery in one, and at the bifurcation of the aorta in one case. Conservative treatment was tried in three cases (one femoral and two popliteal obstructions) but in all three the extremity had to be amputated. Embolectomies were performed on six patients, with five cures.

CASACCI (12) describes a case of cutaneous ulcerated leprosy of the foot, treated by amputation.

In discussing choice, SANTANELLI (13) advocates the Callander amputation in vascular cases because of its simplicity, the fact that the flaps retain a good blood supply from the femoral artery, and that no muscles are cut through. (Ed: A knee disarticulation or a Gritti-Stokes amputation offers the same advantages with even better weight bearing possibilities.)

ELDER (14) reports on the conservation of the foot following injury. As much tissue as is viable should be preserved, and the sacrifice of bone structure in order to obtain flap closure should not be countenanced. Nor is there any necessity to disarticulate the bases of metacarpals even though the heads and distal transverse ligaments may have been destroyed or severely damaged. Equinus or varus deformities may be overcome or guarded against by appropriate operative measure to obviate tendon imbalance when the normal insertion of a tendon has had to be sacrificed. A skilled prosthesis maker must be sought. (Ed: Amputations through the foot need good skin coverage. Many may better be converted to a Syme.)

NABOR (15) abandoned end bearing stumps in cases of amputation of the leg, in favor of the more proximally bearing stump.

REGELE (16) believes that the present practice of covering an amputation stump with muscle tissue should be abandoned and much muscle tissue should be removed at the time of operation. The stump (especially its end) should consist of skin, fascia and bone only.

Effects are discussed by JENNY and AUFDERRMAUR (17) who report two cases

of spondylosis deformans of the lumbar spine due to the wearing of a prosthesis that was too short or too long. In both instances the pathological changes in the spine were due to the abnormal static conditions and occurred after many years of use of the prosthesis.

HELLEBRANT et al (18) studied the effect of lower extremity amputation on the location of the center of gravity, postural alignment and stance stability on 24 unselected subjects. Lower extremity amputation significantly elevates the height of the center of gravity. Prosthetic appliances compensate in part, but not in whole, for this displacement. Postural realignment is necessary to relocate the center of gravity over the middle of the supporting base and should be considered a physiological adaptation essential to efficient use of the prosthesis.

Techniques

Under shoulder girdle, Ralph Cuming, a young British Naval Surgeon is reported by KEEVIL (19) to have performed the first interscapulothoracic amputation in 1808 on a young sailor injured in combat in the West Indies. It was performed without anesthesia and the patient survived the operation to be evacuated to England.

MANCINI (20) reports an interscapulothoracic amputation in a case of fibrosarcoma of the humerus with good clinical result three years after operation.

MERENDINO (21) describes a simple procedure which is applicable to patients subjected to interscapulothoracic amputation in whom a large surface of skin must be sacrificed. Use is made of the full thickness skin from the superior surface of the extremity to be amputated. The proximal portion of the skin remains attached and the flap is placed over the skin defect left by the amputation.

BATZNER (22) reports an interscapulothoracic amputation through a posterior approach for a sarcoma of the upper arm. It was necessary to reverse the usual anterior approach and approach the subclavian artery from behind, because of the extent of the tumor. The entire scapula together with the upper arm was turned forward, exposing the axilla with its nerve and vessel bundles from behind.

GRIMES and BELL (23) discuss the use of the shoulder girdle amputation in the treatment of malignancies about the shoulder, and emphasize the responsibility of the surgeon to propose the procedure rather than allow a major lesion to progress in the face of inadequate surgery. They discuss the advantages of the posterior approach in mobilizing the scapula and in controlling the brachial plexus and the great vessels which are protected by the intact clavicle until the late stages of the operation. In 10 cases there was no mortality from the operation.

Eight articles on hemipelvectomy were published during the year. A literature review by SAINT (24) revealed approximately 185 reported cases of hindquarter amputations. Mortality has dropped from 50 per cent to 15 per cent between 1940 and 1950 because of improved anesthesia, antibiotics and more adequate blood replacement. Tumors, without demonstrable metastases,

involving the innominate bone itself are the primary indication for this type of surgery. A single case including operative technique is described. A detailed account of patient care is included. It is erroneously stated that this amputation cannot be fitted with a prosthesis.

YANCEY et al (25) give a list of the indications for hemipelvectomy: (a) primary malignant osseous and periosteal tumors of the upper femur where the growth has extended to or through the hip joint and for similar tumors of the innominate bones, (b) large primary malignant soft tissue tumors of the upper thigh (involving the hip joint or extending through the obturator foramen), groin, buttock, pelvic parietes, and iliac region are best treated by this type of operation, (c) for palliative reasons, in instances of foul, infected, or painful malignancies of the upper thigh and buttock areas, (d) malignancies located below the knee but with extension up to the pelvic lymphatics and no higher, (e) metastases from carcinoma of the penis or rectum in certain cases, and (f) in very rare instances, for aneurysm of the femoral artery, trauma and massive benign tumors of the pelvic bones or soft tissues. A case is reported. Long superior and medial (inferior) flaps have a better chance of survival than a long anterior flap.

BOWERS (26) describes three cases of hindquarter amputation and one interscapulothoracic amputation for malignant melanoma. Local metastases had occurred in all.

ARMOUR and LAWSON (27) describe a case of hindquarter amputation for Ewing's tumor of the upper end of the femur. The patient is alive and well and walking with a prosthesis five years after the operation.

ROBINSON (28) reports that hindquarter amputation is facilitated by positioning the patient on his healthy side in a modified hip spica. Two operating teams perform the necessary surgery simultaneously, one handling the abdominal approach and the other the sacroiliac approach. The time of the operative procedure was shortened about 40 per cent.

CORYN (29) reports a successful case of hindquarter amputation for osteomyelitis of the hip bone.

BUCKNER et al (30) review a case report of a successful hemipelvectomy for neurofibrosarcoma of the thigh. She was fitted and was able to wear a prosthesis but died eight months after surgery. A plea is made for early diagnosis, if successful treatment by radical surgery is to be accomplished.

LE QUESNE (31) reports that the hindquarter amputation is now possible with low operative mortality by careful preoperative preparation and adequate anesthesia. He uses induction with pentothal, maintenance with nitrous oxide, combined with unilateral spinal block, which enables a light plane of general anesthesia. The incision circumscribes the ilium, which is detached by sections through the pubic symphysis and the posterior wing. The peritoneum and retroperitoneal organs are carefully displaced medially. An indwelling catheter is put in the bladder. He describes a special prostheses which enables those cases to walk fairly well.

FINESILVER (32) reports the results of the cineplastic operation in a series of 17 cases of extensor and flexor forearm tunnels. (Ed: Forearm

tunnels are not considered as efficient as a single biceps tunnel in forearm amputees.) Ten amputees have constantly used their prosthesis at work and the routine pursuits of life over a period of from two to seven years. Of the seven remaining, four use their prosthesis part time, and three are considered failures.

LEBSCHE (33) gives the possibilities of the cineplastic operations for each site of amputation.

KIESSELBACH (34) in a kinetic analysis of Krukenberg's amputation shows that the pronator teres, supinator, biceps brachii and brachioradialis muscles were the most effective muscles of supplying the power required for opening and closing pincers. In a fixed radius the pincers can also be worked by movements of the ulna, the triceps muscle acting as the opener and the brachialis as the muscle effecting the closure. KIESSELBACH (35) also presents a thorough analysis of the muscle action in the Krukenberg arm based on clinical findings and on studies on the cadaver. It is pointed out that muscles change their direction of pull in regard to the axis of motion, depending upon the position of the elbow and the prongs. He compares the operation as done by Kreuz and Bauer. Kreuz believes that all muscle tissue between the prongs should be retained. Bauer states that the muscles on the ulnar side have no functional value and should therefore be removed. The author believes both methods to be too extreme, and points out that the muscle power which is available for closing of the prongs is less than for opening. He believes that some of the muscles should be brought over to the radial prong to reinforce the closing muscles. The rest of the muscles on the ulnar side may be resected.

MOSER (36) reports that a muscle sense develops in cineplastic arm amputees, giving a sense of position of the fingers of the artificial hand. Phantom hand tends to coincide with the artificial hand, a phenomenon considerably enhancing the usefulness of the latter.

PERESSON (37) reports on the results of the 34 cases of Vanghetti's double club or Krukenberg-Putti's forcipate forearm. They were excellent in five, satisfactory in 19, mediocre in five, bad in two and three cases were too recent to assess. In order to obtain a satisfactory prehensile function it is necessary: (a) to save at least two muscles of the forearm besides the supinator and pronator, (b) to lacerate the membrana interossea as proximally as possible, (c) to lengthen the round pronator muscle, (d) to immobilize the stump, as soon as the operation has been carried out, in a position of supination with "fingers" separated, and (e) to start the functional rehabilitation as soon as possible. Putti's stump with short "fingers" has proved more satisfactory than Krukenberg's very long forked stump of the forearm.

KALLIO (38) reports a case of a bilateral Krukenberg amputee who earns his living as a driver. He states that the result in this case emphasizes the Anglo Saxon conception of rehabilitation whereby the same surgeon from the beginning of the treatment has a personal contact with his patient, performs all the reconstructive operations and supervises his training until he is completely established in the employment most suitable for him.

VAN NESS (39) reports that in most types of congenital defect of the

femur, there is severe shortening of the thigh so that the ankle joint of the short limb often approximates the level of the knee joint of the normal side. The author has devised an approach to this problem. First, he corrects the pseudoarthrosis of the luxated hip. Next, he fuses the knee because it is in a useless position just under the hip. During these two steps, every attempt is made to gain 180 degrees of rotation of the ankle. Should this rotation not be fully gained, a rotation osteotomy is performed. By this procedure, the ankle joint can be utilized as an active knee joint. The foot serves as a partial bearing surface. Three cases with eight to ten year follow-up studies are reported.

Complications

In considering pain, MacDONALD (40) in the after treatment of amputation stumps reports that bandaging is one of the most important parts of after treatment of all amputations. Before the stumps can be fitted they must be fully shrunken and almost conical. It must be applied evenly and firmly with the idea of compressing the stump from its end upwards towards its base, and must be applied at least three times daily. Six inch bandages should be used for above knee stumps and four inch bandages for below knee or arm stumps. Hyperextension and adduction exercises should be started while the patient is still in bed. Quadriceps exercises should be performed for below knee amputations. Before fitting, the wound should be healed without infection, without pain nor edema and the stump must be shrunken to a reasonable conical shape.

RUSSELL and SPALDING (41) give a follow-up on report on the treatment of painful amputation stumps by percussion of neuromata and sensitive scars. Their original seven consecutive cases have continued to remain painfree with intermittent percussion being necessary in a few cases. 33 additional cases have been treated with excellent results in 11 cases, good in eight, improved in five. These were all resistant cases. It is suggested that at time of amputation nerve endings should perhaps be left long and accessible for treatment rather than cut short. Sympathetic block or section is still felt to be indicated for cold and diffusely tender stumps.

SMIRNOVA (42) reviews 203 patients with 207 short BK stumps. None could wear their prostheses. Causes of failures were: painful scars - 65; ulcerations - 73; retained suture - 5; exanthemata and pyoderma - 5; osteomyelitis - 19; osteophytes - 8; neuromata - 18; and neuritis - 11. Of these patients, 64 per cent had had a guillotine operation as the primary procedure and no skin traction had been used. She recommended a plastic closure of the stump using posterior rotated flaps as a method of treatment preparatory to prosthetic fitting.

BAR (43) reports that recurrent contractures in two patients with amputation through the upper thigh were due to the development of neuromas on the femoral nerve. Removal of the neuromas was followed by permanent recovery.

CIUFFINI (44) reports that ligature of the nerve stump with a nonabsorbable thread is recommended for the prevention of amputation neuromas. This may be combined with the injection into the nerve of alcohol or of other substances with a similar action.

NAYLOR (45) reports a case of arteriovenous fistula complicating an amputation stump. The fistula probably either originated as the result of a mass ligation of the damaged femoral vein and artery or developed from damage to the arterial and venous walls at the time of the original injury.

In the matter of scars, BLOCK (46) discusses plastic procedures for closing or revising stumps.

MCCOY (47) discusses the problem of reconstructive surgery in the amputee to produce well-shaped scar-free stumps. He advocates full-thickness skin grafts from the opposite limb or abdomen rather than to extend the limits of the scar on the amputation stump.

FRIEDLAND and COUTURE (48) describe a simple, inexpensive brace devised for use in strengthening muscles of the lower extremity in disabled patients, which may be used to strengthen amputation stumps.

The use of tetraethylammonium chloride in treatment of phantom limb is reported by WINSTON (49). A severe case of bilateral phantom limb pain following above knee amputations for obliterative arteriosclerosis with intractable pain is reviewed in detail. This 77 year old man required opiates repeatedly for pain to which he became addicted. Sympathetic blocks failed to give relief. 13 months following the last amputation and 18 months following the first, I.V. tetraethylammonium chloride was administered (Etamon) on four occasions, 2 cc. initially and 6 cc. three times over a nine day span with complete relief of pain. None months later a second series was given for some recurrence of pain following which complete relief has been obtained for over three years. Explanation is offered on the basis that the vasa nervorum may have been affected along with underlying pathology, i.e., obliterative arteriosclerosis producing neuro-ischemia.

LERICHE (50) reports that the phantom pain is the result of irritations, conscious or unconscious, traveling constantly in the sensory fibers in the same manner as in the intact member. The patient does not realize the absence of a certain extremity. The nerve fibers examined will reveal the presence of a neuroma or of the inflammatory changes on the basis of circulatory pathology. Leriche injects these with novocain, dissects out the neuroma with an electric knife and repeats injections of 10 cc. of one per cent novocain for 15 days. The few patients treated by this method showed very encouraging results.

KOLB (51) reports that definitive psychiatric treatment for intractable pain in the phantom limb may be the preferred form of treatment for many patients.

Phantom painful stumps are the most common following severe traumatic amputations where there is infection, scar and circulatory disorder, rather than in amputations resulting otherwise reports BEECK (52). War time amputations seem to have more "phantom limb" than peace time amputations.

LEGER et al (53) report four cases in which small doses of intocostrin, 10 to 40 units daily, resulted after 10 to 15 days' treatment in complete alleviation of pains in the phantom limb. It is suggested that curare acts by inhibiting the actions of the autonomic nervous system.

NOVAK and SIMKOVIC (54) present an analysis of 1636 amputees. Only seven per cent suffer no pain or discomfort. Four per cent have severe pain. Five per cent suffer from painful sensations of phantom limb.

JALAVISTO (55) analyzes a series of 173 arm amputations and studies adaptation in the phantom limb phenomenon as influenced by the age of amputees. The processes thought to indicate adaptation were: disappearance of the phantom sensation, location of the phantom within the stump, and "obstacle shunning" of the phantom when the stump was moved near a wall. These adaptation phenomena developed earlier after amputation and were more frequent (62 per cent) in the young amputees than in the older group (38 per cent).

KALLIO (56) in an analysis of the permanency of results obtained by sympathetic surgery in the treatment of phantom pain followed 68 cases, including eight stelllectomies, 34 lumbar sympathectomies, and 26 infiltrations. In the majority of cases (39) sympathetic surgery was found to have no effect; in 29 cases the immediate results were good, but after one to four years, only six patients reported a complete cure.

STEVENSON (57) reports that the phenomenon of phantom limb, with or without pain, is still largely unexplained and is found to some degree in most amputees. Few of the many forms of operative treatment used for this condition have yielded success, although the method of treating the condition with percussion of the neuromata gives some promise and is currently being tested. In a group of 100 representative amputees investigated by the author, the phantom limb sensation was present in 74 cases, and pain accompanied the sensation in 14. All of the true arm amputees except one experienced phantom limb sensations, and the high incidence of this phenomenon among arm amputees is doubtlessly due to the rich nerve supply to the hand as compared to the foot.

Construction and Fitting

In fitting, ARZIMANOGLOU (58) realizing that a three inch or three inch below knee stump slips out of the artificial limb when the amputee kneels or ascends stairs, and that extension of the artificial limb is practically impossible, offers a "slip" socket made to fit the short stump with a metal rod attached to the inferior surface of the leather socket which rests upon a coil spring. The firm, comfortable grip provided by the socket, and the steady upward pressure of the coil spring, prevent the stump from slipping out of the prosthesis.

RAAGAARD (59) describes a pasteboard prosthesis for above knee amputations which he has found useful in the rehabilitation of elderly patients. A pattern is provided, applicable to most cases, and by its use a prosthesis may be made by simply cutting, wetting, and fitting.

KIAER (60) discusses the proper preoperative and postoperative treatment of amputation stumps of the lower extremities. The desirable amputation techniques for routine fitting of prosthesis are: (a) a conical painless stump, (b) a good myofascial layer at the end of the stump, (c) adequate circulation to prevent edema and necrosis, (d) hemostasis at surgery to prevent deep scar formation, (e) pressure bandaging postoperatively to control edema

and early exercising of the involved extremity to avoid contracture. He feels the cardboard prosthesis should be used only in an emergency.

JOHANN (61) reports that the disadvantages of the physiological knee joint in a prosthesis are (a) foot touches floor on swinging, (b) there is insufficient stability when extended, (c) it is complicated and expensive, and (d) aesthetically inferior to the uniaxial prosthesis.

PEREY (62) reports on a walking school for leg amputees in Berlin. The school offers the limb maker and the therapist a practical laboratory to test new ideas in limb manufacture and use.

Construction is discussed by SCHMITZ (63) who reports a new elastic substance "plastogen" which is used in sockets of prostheses. It can also be used in the finishing of suction prostheses whereby the suction is improved.

MEISSNER (64) reports that reducing friction in the prosthesis to a minimum is necessary, so that the amputee achieves maximum safety and efficiency in walking and standing. The simple hinge joint is preferred.

CANE (65) describes a peg leg which can be made by any medical officer wherever a carpenter is to be found. This artificial leg is only suitable for below knee amputations, weight-bearing being taken by the knee in a kneeling position. It is in fact a simplified form of the historical Chelsea Peg Leg used in England since the Middle Ages. Total cost of completed leg is 13 shillings. About two days is required for patients to become accustomed to walking.

ALDES (66) reports his experience with 49 cases of above knee amputees fitted with suction socket prosthesis. The author concludes that the suction socket prosthesis can be successfully used in about 75 per cent of the above knee amputees if the stump is at least 10 inches in length below the greater trochanter, is well formed and has good muscle tone. The best results with this prosthetic device were obtained with patients between the ages of 21 and 40. The majority of failures with the suction socket are due to poor fitting. The muscles of the stump hypertrophy and increase their physiologic action with the wearing of a well fitting suction socket.

THORNDIKE and EBERHART (67) report that of a total of 606 patients fitted under the National Suction Socket Training Program, 73 per cent were then wearing the device routinely, 14 per cent were alternating between the suction socket and the conventional type limb and that 13 per cent were considered failures.

Under general, GULLICKSON and KOTTKE (68) give a lengthy discussion of the advantages and disadvantages of various amputations, prosthetic fittings, and methods of rehabilitation. (Ed: This article has many discrepancies from what we now consider the most advanced ideas on the subject, particularly as regards the amputation sites in the arm).

POTVIN and POTVIN (69) review advances in the technique of amputation and progress in the construction and fitting of prostheses.

After Care

KESSLER (70) presents an integrated plan for rehabilitation of the amputee. It is patterned after the programmes followed in restoring the 18,000 amputees of the American Forces of World War II.

WERSSOWETZ and BAUM (71) give five major principles of rehabilitation of the amputee which they believe should be followed: (a) psychological and physical preparation of the patient, (b) adequate surgery and postoperative care, (c) preprosthetic treatment and training, (d) proper fitting and alignment of prosthesis, (e) training in the use of the prosthetic device. Considerable stress is given to the psychological and physical preparation of the patient.

MALINOVSKY (72) reports that vocational guidance of the disabled person differs little from that found necessary in the healthy individual but due to the distorted physical and mental frame of mind, guidance of the disabled person becomes complex. In order to evaluate the individual's abilities it became necessary to devise both vocational aptitude and psychological tests. The article reviews the results of vocational guidance in 112 amputees. In 66 per cent of the cases, there was a correlation between the recommendation and the placement, in 14 per cent there was a partial correlation, and in the remainder there was no correlation.

GLOVER (73) discusses the problem concerning the need for performing amputations with complete rehabilitation in mind rather than merely extirpating a diseased member and obtaining a closed stump.

SIEMENS (74) reports two cases of high double thigh amputations for severe flexion contracture of the lower extremities complicating spinal cord injuries with spastic paralysis. They were done to reduce the nursing care, to permit the individual to move about in bed with greater facility and thus minimize decubitus and urinary complications.

MOSKOPP and SLOAN (75) describe the nurse's responsibilities as beginning with the patient's admission and continuing after the amputee is discharged. Proper nursing care can have a very important effect on the full rehabilitation of the amputee.

CAMERON (76) discusses amputations in Malaya. Arterial diseases cause a large proportion of their amputations. Crude simple prostheses are used with little rehabilitation training.

REIFEN (77) and SPIRA (78) report on the social and medical rehabilitation of amputees in Israeli, in a center established in Jaffa.

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CHAPTER XIX

NEW DEVICES, PROCEDURES, AND APPARATUS

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I. X-ray techniques

- A. Planigraphy and differentiation techniques
- B. X-ray examination of the vertebrae
- C. Radiography of the hip

II. Devices

- A. X-ray aids
- B. Surgical aids
- C. Other devices

III. Procedures

- A. Use of wires
- B. Diagnostic procedures
- C. Relief of pain
- D. Tissue repair

IV. Apparatus

- A. Splints, casts, and supports
- B. Prostheses
- C. Aids for locomotion

This chapter, containing 55 references, indicates a wide scope of progress in the development of equipment and methods applicable to orthopedics.

X-ray Techniques

Planigraphy and differentiation techniques are discussed by DJIAN (1). He writes, in an article entitled "Le Tomogramme Vertebral," that planigraph views of the vertebral column including A-P, lateral, and oblique reveal congenital abnormalities in a much clearer fashion than common usage x-ray techniques. Differential diagnosis of osteoarthritis and tuberculous arthritis is made easier by this technique. The anatomical pathology of rheumatic lesions clearly stands out.

OLMO (2), in a brief article on roentgen-planigraphical examination of the skeleton, points out that good diagnostic films on radiographic paper are made possible with planigraphy. Regular film is scarce in Spain. This is a useful method, especially in hip nailing, for demonstrating foreign bodies in the knee joint and for pathology of the temporo-mandibular articulation.

Microradiography of bone is described in an article by SISSONS (3)

who shows that all radio-opaque bone salts can be demonstrated, and thus, an accurate picture of bone architecture can be obtained. Cellular activity is correlated with structural arrangement, and the histology is linked with the findings of clinical radiography. X-rays are taken with fine emulsion films on thin slabs of cut bone of about two millimeters thickness.

Two new methods for x-ray examination of the vertebrae are suggested. A technique for the roentgenographic demonstration of the first cervical vertebra is described by WALTERS (4) who states that visualization of this vertebra can be made through the foramen magnum with no bony superimposition and no obscuration of bony detail. One lateral mass and the corresponding half of the posterior arch can be demonstrated in one exposure and may be duplicated on the opposite side. This method may be used in series study of post-traumatic cases in which a fixed degree of chronicity is present. It cannot be used in fresh cases or in those in which there is a marked limitation of the cervical spine. The upper portion of the patient's head is elevated 12° in the lateral position, and the tube is given a 23° tilt toward the feet. The central ray enters the skull five centimeters above and five centimeters behind the external auditory meatus.

GUERREIRO (5), in discussing the lateral roentgenographic examination of the thoracic spine, reports a most interesting technique for obtaining a full view of this portion without rib obscurrence. With the patient in an orthostatic position with vertebral support, x-rays are taken of the spinal column in profile with the patient breathing deeply and slowly during the course of the exposure. 50 KV and 15 MA for 15 seconds at a focal distance of two meters is used. Complete disappearance of the ribs from the plate occurs, and the spine is clearly outlined. This technique is excellent for detail of small compression fractures and arthritic developmental changes in the posterior portion of the body and in the articular processes.

Profile radiography of the hip in vertical position is described by SEZE et al (6) who use the tube between the abducted legs and the ray directed up through the femoral neck with the plate parallel to the neck and held tangentially on the iliac crests or with the plate and tube reversed which provides a method for obtaining good lateral projections of the head and neck of the femur. These views aid in the diagnosis of cases of congenital subluxations and other arthritic and dysplastic conditions of the hip joint.

BRIDGMAN (7) reports in an interesting article, "Radiography of the Hip Joint, Lateral Projection -- Extremity Extended," that two techniques with the patient supine are possible. The first is accomplished with the long edge of the 8 x 10 cassette resting vertically along the table top alongside the coxal region and the proximal short end pressed firmly into the patient's side above the crest of the ilium. The distal end of the cassette is moved away from the lateral aspect of the thigh until the plane of the film is perpendicular to the central ray. The tube is placed between the patient's legs with the unaffected limb abducted and even resting on the tube tunnel. The localization point is one inch caudad to the iliac anterior superior spine and in the horizontal plane passing through the greater trochanter. In the second technique, the cassette is placed alongside the upper femoral region but held at a 65° angle, the junction of the upper two-thirds and lower one-third being opposite the greater trochanter. The central ray comes in at a 25° angle above the unaffected opposite limb. Both

techniques give excellent views of the femoral head and neck region. This is a must in hip nailing.

Devices

X-ray aids which further enhance the value of roentgenography in orthopedic surgery are presented. JACKSON BURROWS (8) of England describes a variable scale for measuring from radiographs in Smith-Petersen nailing which is used in hip nailing for arthrodesis and removes errors which may occur in reference to the magnification of the radiographic image. A graduated measure in one-half and one centimeter markings on stout rubber is extended telescopically by means of a milled screw head. The x-ray shadow is equivalent to real centimeters in the body. The use of the scale relieves the surgeon of mental arithmetic.

A simple adapter for mounting the head of an x-ray tube to a fracture table is described by LEONARD et al (9), and this apparatus permits the obtaining of diagnostic antero-posterior and lateral roentgenograms quickly without displacement of the fragments or contamination of the wound in the closed nailing of fractures of the femoral neck. The adapters permit the tube head to be moved in three directions, and they may be attached to either type of fracture table. Tube head flexibility is much greater than when the head is fixed on a sacral rest.

A large number of surgical aids are described. ROBSON (10) describes a table attachment for the electric saw which makes the use of the saw a safe procedure for one surgeon. The free saw is converted into a bench saw by means of a base plate and table of stainless steel. The blade rotates toward the operator and is exposed through a slot in the table. The motor is securely locked in place on the base plate. Markings of one-fourth inch on the plate assist in measuring graft widths. The instrument is easy to construct and has given complete satisfaction in its use.

An adjustable bone-holding forceps, described by CHIRINOS (11), has a horizontal position which enables the operator to see the fracture site clearly and to apply screws and plate without obstruction. Butterfly nuts allow the superior arm of the apparatus to be adjusted for different thicknesses of bone, and different sizes are available for various bones. The use of this instrument is first reported at McClosky General Hospital in Texas in 1945.

CANTOR (12) describes a new biopsy forceps which apparently has many merits. Most biopsy forceps have their jaws arranged in alligator-like fashion, consequently lacking cutting force, and tearing of tissue becomes necessary in order to remove a specimen. In this new instrument, there are no jaws, and the cutting is done by an actual punch operation. By squeezing the handles of the instrument, the inner tube of the punch is simply moved forward, and, being of sharpened, hardened cutting steel, it cuts the tissue into the receiving cup cleanly and without tearing. For extremely hard tissue, cartilage, or bone, the inner cutting tube can be rotated by means of a milled handle at the control end of the instrument.

MERVERDING (13) describes a mallet to be employed in the performance of surgical procedures on bone and states that it is conical in shape, weighs

two pounds, and is 8-3/4" long with a hexagonal handle. It has the following advantages: (a) it is heavy for easy wrist motion for a powerful blow, (b) the operator can strike the chisel head and still keep his eye on the cutting edge which is not diverted by the full transmitted force of blow, and (c) the problem of injury to hand and glove as present with light smaller mallets is eliminated.

BRUNER (14) describes a retractor for hand surgery which is modeled after the old-fashioned buttonhook, made of stainless steel, and provided with a suitable handle. It is used as a tendon extractor or retractor and, being smooth, causes little trauma in the finger, palm, or wrist.

A self-retaining retractor for operations on long bones, described by HIPPS (15), constantly exposes more than one-half of the circumference of a long bone in the field of operation. It does not need to be held in place, is easy to apply, needs no adjusting, and is easily constructed by a machinist or brace maker. Two pieces of strong metal tubing are shaped with a central half-circle dip to go around the bone and are connected by a solid extension on one arm to fit into the other arm of the hollow tube.

VON LACKUM (16) describes the Universal stapler which has a long grasping tool and wrench for a hexagonal nut which tightens the jaws to hold any size staple and permits staples to be introduced into wounds of considerable depth. The nut is easily loosened by the long wrench, and a groove on the end of the impactor is used against the transverse bar of the staple to drive it home.

A simplified drill for the Bankart operation described by ALFRED (17) is created by a right-angle burr used in the perforation of a maxillary antrum. The burr is removed, and a steel drill point 5/8" long and 3/32 gauge is attached to the chain drive. Usual exposure is fully adequate for the proper placing of the drill point, and the angle of the drill is in perfect relation to the glenoid rim. Only a few turns of the drive shaft are necessary to drill through the rim.

CLERY (18) describes a simple device to facilitate split-skin grafting. Subcutaneous Kirschner wires at each extremity of the donor skin site are held with traction stirrups, and a silk suture from the skin edge to the stirrup nicely delineates an area of skin to be removed with the Blair knife. The donor site is thus elevated and stretched evenly so that a uniform wide graft may be easily taken.

Other devices depicted include a pin and stirrup for skeletal traction which PAUL (19) describes. He points out that loosening of a pin in bone may be caused by application of a wide stirrup that holds the pins rigidly. The apparatus described permits rotary motion of the stirrup about the pin but is narrow enough to prevent sideward thrust and motion. The narrowness of the stirrup is maintained by a transverse clip to the stirrup arms. This clip is fixed with a butterfly nut to prevent slipping or springing off.

A modified goniometer with practical improvements is introduced by BERRESHEIM et al (20). This is a precision instrument with telescopic arms and a 360° scale and is adaptable to all joint motions. Being of transparent plastic material, it allows specific placement of the axis on landmarks,

and the weight is minimized. A thumb-screw feature at the base of the arms eliminates the necessity of excessive handling, while the well-defined markings on the face of the instrument enable the operator to read the measurement with ease.

GIBBENS (21) describes an easily constructed, inexpensive, rubber walking heel which is nailed to a wooden block four inches long and the same width of the heel. 30 inches to 34 inches of coat hanger wire is threaded through the center of the heel from side to side, extending upward to conform to the plaster boot. One or two rolls of four inch plaster hold the wooden block and wires to the sole and sides of the leg cast. The following advantages are pointed out: (a) it provides good balance, traction, and stability, (b) it is light and less prone to tear up bed linens, floors, and rugs, (c) it is less likely to slip on wet or smooth floors, (d) it is inexpensive and easy to construct from readily available materials, and (e) after use, the heel may be cut from the cast and used again.

DUNLAP and KOODA (22) introduce a new contact bone plate. In this plate, there is 3/8 inch of movement taking place between two hooked plates which are contained within a stainless steel, tubular sleeve. The plates allow for three-hole fixation screw placements which are tightened against the bone cortex. There is no stress on the screw head or neck. Long plates may be used without fear of screw breakage.

A simple, but rather ingenious, cast spreader is described by STEWART (23). This spreader, which is both simple and effective, may be made from an automobile valve lifter. Two metal plates are brazed on the inside of the jaws. Good leverage is provided, and the ratchet attachment to the handles allows the blades to be held apart while underlying wadding is cut.

Procedures

The use of wires in orthopedic surgery is demonstrated by three authors. CHARNLEY (24) of Manchester, England, describes a method of inserting the Smith-Petersen guide wire. A cannulated screw, with a tapering thread and controlled by a long-handled box-spanner which fits the hexagonal head of the screw, is introduced through a 3/16 inch hole into the cortex of the femur in the direction desired for the nail position. Through the cannulated screw the guide wire is introduced and x-ray films taken. If the guide wire is not in satisfactory position, the cannulated screw is reintroduced at a different angle, and another guide wire is placed. X-rays will reveal proper positioning. The threaded screw may be used in about four cortical positions to serve as a guide to the wire. This method prevents the difficult positioning of the second guide wire as advocated by Watson-Jones. Nail length is determined by measurement of the three inch threaded screw on the A-P x-ray film, and the factor of magnification is corrected by a simple graph chart.

DEAN (25) writes an interesting paper discussing some surgical and technical aspects in the usage of wire sutures. Little or no tissue reaction is caused, and, in wound complications such as infections, hemorrhage, or necrosis, the wire sutures have a passive role and do not interfere with secondary wound healing. Wire sutures alone cannot prevent dehiscence in wounds in patients with marked nutritional deficiencies. Ionization and electroly-

sis are not factors to be considered with the use of stainless steel wires. All wire sutures must be kept clean and free from rubber, oil, and resins which would contaminate the suture. Mixing of different alloys in wounds is not recommended. Sound judgment in the use and placement of sutures will allay the fear of wire migration to a vital structure.

Skeletal suspension in the treatment of decubiti is described by CLARK (26) who states that skeletal suspension to avoid added pressure to areas of decubitus has been successfully accomplished by using Kirschner wires in the iliac crests and clavicles. The wires are connected to traction bows, and, by means of ropes, pulleys, and weights, the patient may be easily suspended for definite time periods during the day. With the pelvic suspension, his bed pan problem is made much easier. This method definitely helps the pre-operative phase for plastic closure of decubiti.

Among the articles on diagnostic procedures is an article by GOLDSTEIN and DREISINGER (27) describing a method for measuring the length of the bones of the lower extremity which is called spot orthoroentgenography and is a modification of Green's technique. This method has been used since 1947. Standard x-ray equipment is needed plus a cassette 14" x 36" and a brass cylinder 26" long and $4\frac{1}{2}$ " in diameter. Six rapid exposures are made over the ankle, knee, and hip joints, and the left wrist and hand are also taken on the same film for determination of bone age. 40" target film distance is as accurate as greater distances and is more convenient. Individual exposures eliminate the distortion due to limb-length inequality, and, with a slight cost increase, this new equipment is easily added to existing standard x-ray apparatus. Sources of error are the positioning of joints and possible shrinkage and expansion of the film.

SHEA et al (28) write an interesting paper on electromyography in the diagnosis of nerve root compression syndrome. They report the use of this procedure, utilizing the monopolar needle electrode technique and a cathode ray oscilloscope, in 75 cases of compressive lesions of spinal nerve roots (14 cervical, one thoracic, and 60 lumbosacral). Their results show this method to be accurate in 68 of the 75 cases. In contrast, myelograms are reported to be correct in 58 of 68 cases. Both methods are checked by operative findings. The diagnosis of specific nerve root compression is made by finding of voltage characteristic of denervation fibrillation arising only from the skeletal muscles supplied by that particular nerve root.

For relief of pain, COONRAD and BAKER (29) advocate, with certain reservations, intravenous procaine therapy. They present an interesting paper on the subject and make an evaluation of the results of 245 cases of various pain disorders. In 245 patients with 447 injections, there are only seven mildly toxic reactions which are uncomplicated and without morbidity or mortality. 250-30 milligrams of procaine HCl in 300 cc. n/saline is given over a period of 20 minutes, and 90 to 120 milligrams of sodium phenobarbital is given intramuscularly 20 to 30 minutes before the therapy. The authors conclude that use of the drug is of clinical value in relieving pain. Best results are seen in those patients with traumatic myositis, acute torticollis, or delayed serum sickness. In these, the relief of pain is immediate, pronounced, and of long duration. Results are not as satisfactory in other pain syndromes.

Useful procedures to be employed in tissue repair are presented by several authors. BATALHA (30) describes a new method of intraarticular arthrodesis by transposition of local cancellous bone by means of a tubular saw which removes the cancellous graft across a joint, e.g., hip or humerus. Graft is driven out of the saw, and the cartilage is removed and then reinserted to proper depth. Operation is extra-articular, with little shock, and the method leads to firm, rapid fusion by using local cancellous bone. Local blood supply is not disturbed by severe open operation, and five cases, three hips and two shoulders, are reported with excellent results.

TENEFF (31) tells of method of osteosynthesis of the lumbar vertebrae. Bone grafting of the lumbar vertebrae used in non-infectious diseases is done by means of a left side, lateral lumbar approach anterior to the transverse process. Notches are prepared in the vertebral bodies and are filled with an osteo-periosteal graft. The operative approach is easy, and the results are positive.

COLE (32) describes the immediate tendon repair with fascia lata transference in a compound fracture treated with aureomycin. The tendon plastic procedure reported, done at primary operation in a contaminated compound fracture of an index finger, employs the use of aureomycin, 600 milligrams per day. The author reports that in two weeks immobilization was removed and primary healing had taken place. Motion was started in two and one half weeks. Thus, with coverage by antibiotics, a long delayed secondary repair is prevented, and early repair gives a better prognosis.

MULLER (33) explains the construction of a palmar post. In gunshot wounds where most of the palm and all the fingers except the thumb have been shot away, it is advisable to construct an apposition post for the thumb to function against. Pinch and grasping are then possible, and the entire hand may be quite functional. In the case described, abdominal tube flap provides the skin, and the bony core is constructed from iliac bone.

SHEEHAN and SWANKER (34) report an interesting technique for the use of gelatinized bone for the repair of skeletal losses. Iliac bone is fragmented and moistened with a solution of fibrin foam and topical thrombin before it is ground in a conventional grinder from which it emerges as a brown, gelatinous substance. A cohesive mass is finally obtained by the addition of more fibrin foam and thrombin. This gelatinized bone is placed at the graft site by means of a spatula. Successful grafting is reported with this method in 20 cases for mandibular losses, malar flatness, depression of the nasal bridge, depressions of the orbital floor, and defects of the maxilla, frontal sinus, and cranium. This method can be applied to orthopedic surgery in any bone defect and may overcome the wandering effect of isolated chips.

A now very popular incision, the posterior exposure of the hip joint is described in detail by GIBSON (35) of Winnipeg, Canada. This incision has been used by the author during the last 35 years. It is a modification of Kocher's posterior approach, and it has several advantages. As an approach, it is rapid, almost bloodless, and attended by little shock. The power of the muscles is unimpaired as they are not detached from an extensive iliac origin. The gluteus maximus and tensor fascia lata, which are so important for stability of the hip, are not weakened, and the operation causes no instability. Dislocation of the femoral head from the acetabulum is

easily done by flexing the thigh and rotating it laterally. Uses for this incision would include reduction of posterior fracture dislocations of the hip joint, replacement of slipped upper femoral epiphysis, exposure of sciatic nerve in the buttock, treatment of injuries to the gluteal arteries, arthrodesis of the hip joint, and finally, cup arthroplasty or femoral head prosthetic replacement. The patient is placed on the sound side in the lateral position with kidney supports for positional maintenance.

Apparatus

In this section, most of the material contributed has to do with splints, casts, and supports. SCALES (36) of London, England, describes the use of polyethylene and resinated asbestos felt for splints and feels that this procedure is recommended. His reasons are that, excluding curing, production time is approximately one-quarter of that required for cellulose acetate or molded leather splints, which have to be steel reinforced, and the cost is about one-half. Other advantages claimed for the material are that it is light and durable, does not distort with use, is washable, is unaffected by sweat, urine, and feces, and is non-inflammable. It has been used for rigid splints such as pylons, spinal jackets, spicas, and long leg gutters.

The self-retaining hoist, a new method of nursing in major orthopedic procedures, is described by HARRIS (37) of Australia. The self-retaining winding gear is a U. S. Navy bomb hoist or a similar mechanism incorporated in any modern rotary clothes hoist. The self-retaining feature allows patients to operate it themselves. Lifting of the patient is effortless, and jerking is literally impossible, the velocity ratio of the hoist being 1:40. Venetian blind webbing is used as straps on plaster casts, and these are connected by separate rings to a large, central, metal ring which is attached to the pulley rope. No strain or breaking of plaster casts is reported, and nursing care is reduced.

LEVY (38) describes an appliance to induce toe flexion on weight bearing. The author uses a molded latex sole which is impressed to the foot with the toes in flexion. This elevated soft ridge at the metatarsal heads allows for active toe flexion when the patient is walking. Plantar muscles are toned, and the transverse arch is elevated causing disappearance of callousities and symptoms of painful prolapse. The appliance has no value in cases where the toes are fixed or cannot be passively moved 10°.

SCHULZ (39) states that celastic splints are durable, waterproof, lightweight, and adjustable. He says further that they may be used to advantage in an arthritic program. Full details are given (with necessary precautions because of the inflammable nature of the solvent) for the construction of various splints. The cost of construction is moderate.

Reciprocal motion skis for cerebral palsied children are described by KUHNEN (40) who claims that they teach a reciprocal pattern of walking, strengthening various muscle groups and teaching balance while in motion. The child is taught proper distribution of body weight, e.g., the balance of the right upper quadrant over left lower quadrant and the left upper quadrant over the right lower quadrant. The child may also practice walking backwards. Ski walking is the final step before walking unassisted. There is a good illustration of the apparatus in use with a detailed guide for con-

struction and use.

SHORBE and McBRIDE (41) describe a convex saddle frame which consists of two tubular steel pieces with convex curves reaching 9-3/4" from the horizontal and being about 32" in length. These convex double bars are well padded, and their widths are adapted to the patient's pelvis and shoulders by means of telescopic bars at each end which have adams set screws. The frame is used both in cervical and lumbar spinal operations, and abdominal pressure is eliminated in these positions. The chest and arms are free, and anesthesia is enhanced because of no direct anterior thoracic pressure. The convex spinal position gives much better laminar exposure.

MOORE and EDMUNDS (42) describe a prone position frame which is another convex saddle frame made of 1" plumbing pipe. Two curved, vertical bars slide on an "H" frame by means of T-pipe connections which are held in correct positions by set screws. The frame is adjustable for width only. Highest central point is 10", and the total width is 18 $\frac{1}{4}$ ". The curved bars are covered with felt, 2" of sponge rubber, and, finally, a Koroseal washable cover. Pressure bruises may occur over the maximal points of pressure on the iliac crest and side of the body. These are usually minimal, and there is no tissue slough. 80 successful cases are reported using the frame.

A table extension to aid in application of a shoulder spica, described by MAGILL (43), is a tripod supporting a sponge rubber filled metal cup open on one side for the patient's head and a removable back support from the tripod to the table. It is a useful adjunct in work on reduction of fractures of the clavicle and in the application of plaster in forms of spicas, vests, and figures of eight.

BOHSTEDT (44) describes an arm-traction apparatus which enables the bed patient to be elevated from a horizontal to an inclined or sitting position while the arm traction is kept in alignment at all times. Positional changes prevent hypostatic lung changes, especially in aged patients. The apparatus consists of a board clamped crosswise on the head end of the bed springs. To this are attached the standards for lateral and vertical traction. An anchor counter and pull part may be applied to the opposite side of the board.

BUNNELL and HOWARD (45) describe additional elastic hand splints which are used to exercise, mobilize, and change the position of stiffened joints in injured hands, coaxing joints into position of function, or to complete the muscle balance in paralysis. Splints are used to change a hand from a position of a flexed wrist with fingers extended into a position of function. Single splints are used for single involved fingers. One set of splints draws out flexion contracture of the proximal finger joints seen in ischaemic fibrosis of muscles of the hand. This is a reverse knuckle-bender. Good illustrations are provided.

RUDOLPH (46) states that use of overshoe buckles in brace cuffs relieves the difficult problem of fixing laces or straps and buckles for patients with hand disabilities as seen in poliomyelitis, cerebral palsy, and hemiplegia. The buckle is adjustable for loose or snug fit by means of its eyelets, and it represents a simple, time saving, and independent maneuver for the physically handicapped.

A bamboo staff for deltoid paralysis is described by SCOVILLE (47) and is used in the place of the more cumbersome airplane splint for maintaining arm elevation. It is provided with a rubber crutch tip at one end and a cross bar and soft leather thong for wrist attachment at the uppermost end. The pole is pushed with the contralateral arm. The apparatus has good use indoors for patients with minor brachial plexus paralysis.

VAN DYKE (48) describes a trochanteric splint which is a practical device for preventing external rotation of the hip and lower extremities, especially in polio. It is noted that, even with the feet against a foot-board, the metatarsal region will remain in place against the board while the legs rotate externally, producing varus and cavus foot deformities. Angled boards form a concavity which is filled with sponge rubber, and white felt webbing straps encircle the patient and hold the splints securely and comfortably. The felt is tapered off to prevent pressure sores.

Practical adaptations for new types of prostheses are shown. ARZIMAN-OGLOU (49) describes a prosthesis attachment for short amputation stumps below the knee. This is used to prevent a short stump (2" to 3" long) from slipping out of the artificial limb when the amputee kneels or ascends stairs and to obtain better extension of the artificial limb. A leather socket fits the short stump, and a metal rod runs from it to the foot section where a coil spring exerts upward pressure on the rod, thus giving the patient the feeling he is walking on his own foot. The apparatus does not have the difficulties encountered in the ordinary prosthesis. The whole system is fitted into a conventional artificial limb.

SHEAR and COMARR (50) describe a triceps substitute brace for quadriplegics used in cases of spinal cord injury where the biceps is spared and the triceps knocked out. The brace restores muscle equilibrium and allows for sufficient function of the elbow joint, permitting use of eating utensils, combs, brushes, etc. It offers resistive exercise for the biceps, acts as a cock-up splint for the hand, and furnishes an improved holder for eating devices. All contact points are covered with elk skin and padded with foam rubber. It is constructed of surgical steel and weighs only one and one-fifth pounds. The elbow joint is a hinge type with an incorporated spring.

Aids for locomotion are proposed by five authors. YAMSHON (51) describes an aid to walking for patients with spastic hemiplegia which is provided by elevating the sole and heel on the normal foot, facilitating the breaking of contact between the ground and the involved foot. This, in turn, diminishes the positive support reaction and stretch reflexes and allows for more adequate use of residual voluntary motion. Ambulation is improved by a decrease in the degree of shift of the center of gravity beyond the normal when weight is borne on the normal leg. Weight bearing is encouraged on the involved leg, and the step relationship in time and length of step between the normal leg and the involved leg is improved.

A brace for the correction of inversion tendency in clubfoot is described by HAUSER (52). It is designed to keep the feet in abduction and external rotation while the child walks. A long metal rod is attached to the anterior part of the shoes, and the shorter rod is attached to the heels, both on the medial side. Rod length is determined by the size of the child and the length of steps desired. The front rod is usually 3" to 4" longer

than the heel rod. Hinges connected to the rods are attached to a flat metal plate which is inserted between the layers of the sole and heel, and this arrangement allows motions in all directions.

DEAVER (53), in an interesting article on wheel chairs, stresses the point that the wheel chair must be suited to meet the needs of the disabled person. Comfort is important as well as the requirements of the area in which the chair is to be used and the obstacles that the area presents. All types of wheel chairs are discussed including descriptions and actions of such component parts as the wheels, brakes, back rest, arm rests, seat, foot boards and leg rest panels, trays, and toe-loops and heel straps.

DEAVER (54), in a second article, writes an interesting dissertation on what every physician should know about the teaching of crutch walking. Crutch walkers should learn a fast gait for open speed as in street crossing and a slow one for crowded places where balance must be kept. A variety of gaits should be taught to all crutch walkers, thus using different combinations of muscles and preventing fatigue from one common gait. Crutch gaits are really exercises strengthening many locomotion muscle groups. Crutch selection, measurements, muscular training, and various gaits are described.

FRIEDLAND and COUTURE (55) describe a progressive resistance exercise apparatus for physical rehabilitation of patients with amputations, fractures and paralysis of the lower extremity. The apparatus is basically a strong, double, upright knee cage with hinged, sliding, locking knee joints with long, leather laced cuffs for the thigh and leg. At the distal end, the uprights are bent backward at a right angle and continue for $3\frac{1}{2}$ " where the uprights terminate in rings which permit the insertion of a metal rod to each end. Weights may be added to these rods, and exercises may be given by means of using the locked or unlocked apparatus. This apparatus may be used with amputations, fractures, and paralyses of the lower extremities, and increasing resistance is easily controlled by addition or subtraction of weight attachments as described.

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AUTHOR INDEX

- Abbot, A. F., 78, 84
 Abel, H. A., 213, 223
 Abel, M. S., 178, 186
 Abrahamson, M. L., 95, 111
 Abrams, H. L., 151, 157
 Adams, D. K., 95, 111
 Adams, J. C., 175, 185
 Adcock, J. D., 40, 44
 Adson, A. W., 142, 153
 Aegeerter, E. E., 28, 35
 Ag Assiz, C. D. S., 87, 108
 Aimes, A., 133, 139
 Ajuriaguerra, J., 115
 Akad, N., 203, 208
 Ala Jouanine, T., 94, 111
 Albert, A., 54, 67
 Albrecht, K., 172, 183
 Aldes, J. H., 278, 283
 Alexander, O. M., 232, 241
 Alfaro, A., 3, 11
 Alfaro, S., 3, 11
 Alfred, K., 288, 296
 Allende, G., 39, 44
 Allergee, G., 237, 243
 Alt, L. P., 65, 71
 Altemeier, W. A., 65, 71
 Amos, J. D., 53, 71
 Anderson, K. J., 139
 Anderson, M. E., 35, 260, 268
 Anglin, C., 83
 Anglin, C. S., 84
 Annersten, S., 253, 265
 Antelo, J. N., 221, 226
 Appel, D., 173, 183
 Applebaum, E., 78, 84
 Aranda de Rojas, M., 39, 44
 Archibald, R. M., 10, 15
 Arden, G. P., 26, 34
 Arkin, A. M., 27, 35, 158, 159, 160, 162
 Armanet, B., 39, 43
 Armour, J. C., 273, 281
 Armstrong, M. P., 74, 82
 Arnaud, M., 173, 184
 Arnould, G., 101, 114
 Aronovitch, M., 39, 43
 Arons, P., 19, 32
 Arseni, C., 237, 243
 Arvay, N., 17, 31
 Arzimanoglou, A., 277, 283, 294, 298
 Ascenzi, A., 65, 70
 Ashby, John D., Maj., 37
 Asherman, E. G., 232, 241
 Ashworth, D., 62, 70
 Aspin, J., 24, 33
 Astley, C. E., 103, 115
 Aub, J. C., 7, 14
 Audier, P. J., 170, 182
 Aufdermaur, M., 271, 280
 Austin, E., 80, 85, 116
 Avernier, L., 254, 265
 Axhausen, G., 26, 34
 Bachet, M., 168, 181
 Baeder, D. H., 54, 67
 Baker, G. S., 100, 113
 Baker, L. D., 290, 297
 Bakwin, H., 8
 Balcher, M. R., 56, 67
 Balla, G. A., 49, 51
 Ballantyne, D. A., 248, 264
 Banerji, D., 261, 268
 Bar, H., 275, 282
 Barber, C. G., 132, 139
 Bariety, M., 24, 34
 Barnes, A., 12
 Barnett, H. E., 88, 108
 Baro, W. Z., 168, 181
 Barrett, 258, 267
 Barron, T. S., 201, 210
 Barsant, A. W., 79, 84
 Baruk, H., 103, 104, 115
 Baskin, J. L., 75, 83
 Basom, W., 287, 296
 Basset, G., 54, 67
 Bastagli, D., 101, 114
 Bastien, P., 203, 208
 Batalha, E. S. C., 291, 297
 Batzner, K., 272, 281
 Bauer, G., 48, 51
 Baum, M. W., 279, 284
 Bauman, C., 167, 180
 Baumann, J. A., 233, 241
 Bazzi, T., 101, 114
 Bean, W. B., 111
 Bearzy, H. J., 203, 208
 Beath, T., 214, 223
 Becker, H., 100, 113
 Becks, H., 65, 71

- Beeck, M., 276, 283
Belenger, M., 137, 141
Belgrano, M., 159, 162
Bell, H. G., 272, 281
Belz, F., 173, 183
Benassi, E., 161, 163
Bender, H. R., 150, 156
Benes, V., 189, 197
Berg, C., 251, 264
Berne, C. J., 57, 68
Bernhard, E., 256, 266
Bernhard, W. G., 261, 268
Berresheim, F., 288, 297
Bertrand, I., 111
Bertrand, L., 25, 34
Beyssac, P., 23, 33
Bianchi, F., 246, 263
Bickerstaff, E. R., 103, 115
Bikfalvi, A., 271, 280
Binde, H., 101
Binet, J., 133, 139
Binet, J. P., 135, 140
Bingham, R., 92, 110
Bingold, A., C., 212, 223
Bishop, R. E., 38, 43
Bisotti, P. L., 220, 226
Black, H., 96, 112
Blackstone, D. P., 166, 180
Blair, J. D., 132, 141
Blanche, D. W., 175, 185
Blankoff, B., 189, 197, 202, 208
Block, H. E., 165, 186
Block, W., 276, 282
Bluefield, C., Jr., 150, 156
Blum, H. L., 76, 83
Blunt, J. W., 54, 67
Bly, C. G., 56, 67
Bobroff, A., 218, 225
Bodman, F., 173, 184
Boecker, W.,
Bogen, E., 40, 44
Bohler, J., 135, 140, 232, 241
Bohning, F., 20, 32
Bohr, H., 119, 129
Bohstedt, G., 293, 298
Boissy, R., 230, 240
Bolgert, M., 29, 36
Bolton, H., 255, 266
Bonar, A. A., 204, 209
Bonnal, J., 115
Bonola, A., 136, 141
Booth, W. G., 217, 224
Borger, G., 171, 182
Bosch, D. T., 261, 268
Bostick, W. L., 144, 153
Bosworth, D. M., 39, 43, 121, 129
Bothelheiro, J., 192, 198
Boucher, C. A., 216, 224
Boucher, R., 30, 36
Boudin, G., 111
Boulvin, R., 247, 263
Bourel, M., 54, 67, 202, 208
Boutelle, W. F., 130
Bovissou, H., 40, 45
Bower, A. G., 77, 83, 85
Bowers, R. F., 273, 281
Boyd, J. D., 105, 116
Boyes, J. H., 251, 264
Boyes, J. W., 91, 110
Bradford, C. H., 126, 131
Bradford, F. K., 173, 183
Bradlow, P. A., 22, 32
Brady, T. A., 38, 42
Brady, W. C., 86
Brailsford, J. F., 143, 153
Brandman, O., 219, 225
Brandt, H., 40, 45
Brannon, E. W., 10, 15
Brauer, R. O., 47, 51
Brault, P., 195, 199
Brav, E. A., 132-141
Breck, L., 287, 296
Brennan, J. J., 211-226
Bridgman, C. F., 286, 296
Brightman, I. J., 108
Brimfield, C. H., 166, 180
Brion, S., 33
Brixey, A. M., Jr., 2, 11
Brochier, A., 1, 11
Brochier, I. E. W., 158, 162
Brockbank, W., 190, 197
Brockway, A., 132, 139
Brooks, D. M., 249, 264
Bruesch, S. R., 75, 82
Bruner, J. M., 257, 259, 267, 288, 296
Brunsting, H. A., 247, 263
Brown, C.H., Lt. Col., 37
Brown, F. M., 75, 82
Brown, J. B., 236, 242, 243
Brown, J. E., 216, 224
Brown, S., 58, 68
Brownell, E. G., 150, 156
Brua, R. S., 165, 186
Brucke, H., 137, 141
Brush, B. E., 47, 51
Buchan, J. F., 146, 155

- Buckland, M. G., 147, 155
Buckner, H. T., 273, 281
Bucy, P. C., 145, 154
Buff, H. U., 257, 266
Buffat, J. D., 174, 184
Buirge, R. E., 203, 208
Bulgarelli, R., 17, 31
Bunnell, S., 256, 266, 293, 298
Burgen, A. S. V., 59, 68
Burke, R. M., 2, 11
Burkhart, E. F., 2, 11
Burkle de la Camp, H., 136, 141
Burman, M., 204, 209, 229, 239
Burns, H. A., 40, 45
Burns, J. E., 47, 51
Burtt, E. J., 108
Bushra, E., 8, 14
Bustos, F. M., 170, 182
Butori, 190, 197
Buxton, S. J. D., 217, 224
- Cacciapuoti, G. B., 97, 112
Caffaratti, E., 254, 265
Caffey, J., 18, 32
Caldwell, G. A., 228, 239
Callahan, J. J., 273, 281
Calon, P. J. A., 95, 111
Cameron, J. A. P., 279, 284
Campanario, M. de A., 169, 181
Campbell, D. A., 49, 51
Campbell, K. N., 219, 225
Camp, H. Burkle de la, 136, 141
Cane, L. H., 278, 283
Cannon, B., 258, 267
Cantor, A. J., 287, 296
Capecchi, W., 206, 210
Carlsale, P. L., 203, 208
Caro, D. L., 143, 153
Caron, W. M., 256, 266
Carr, C. R., 86, 91, 109, 116
Carr, D. T., 40, 44
Carter, A. B., 220, 226
Carter, E. K., 150, 156
Carter, S., 94, 111
Carttar, M. S., 50, 52
Casacci, A., 271, 280
Casiraghi, J. C., 179, 186
Caspe, S., 61, 69
Cassebaum, W. H., 122, 130
Castillo-Odena, I., 204, 209, 231, 240
Catchpole, H. R., 56, 67
Cavalcanti, M., 231, 240
Cavallaro, W. V., 192, 198
- Cave, E. F., 205, 209
Cavina, C., 161, 163
Cawley, P. F., 39, 43
Certonciny, A., 160, 163
Chambers, G. H., 187, 200
Chandler, F. A., 145, 146, 154, 155
Chapchal, G., 136, 141
Chapman, R. J., 173, 183
Charnley, J., 289, 297
Charry, M. R., 191, 198
Charry, R., 189, 197
Chavany, J. A., 99, 113
Chaves, D. A., 192, 198
Chesney, M. O., 220, 226
Cheynel, J., 193, 199
Chiapella, W. C., 83
Chiari, H., 161, 163
Chigot, P., 109
Chigot, P. L., 169, 181, 193, 198
Chinoy, J. J., 7, 14
Chirinos, J., 287, 296
Chopin, B., 109
Christensen, E., 88, 108
Christie, H. K., 134, 139
Christopherson, W. M., 146, 154
Chusid, J. G., 103, 115
Ciuffini, F., 275, 282
Clagett, O. T., 90, 109
Clark, A. G., 290, 297
Clark, E. M., 82
Clarke, H. H., 59, 69
Clarkson, P., 258, 267
Clery, A. B., 288, 297
Cleveland, M., 117, 129, 211, 223
Clivio, I., 136, 141
Clybourne, H. E., 135, 140
Cohen, L., 104, 115
Cohn, C., 109
Colantuono, A., 39, 43
Cole, F. R., 291, 297
Coley, B. L., 143, 149, 153, 156
Collard, A., 31
Collazo-Gonzales, P.J., 72-85
Colling, K. G., 100, 114
Collins, D. H., 145, 154, 212, 223
Collins, V. P., 18, 32
Collis, E., 108
Comarr, A. E., 294, 298
Compere, C. L., 27, 34
Compton, J. W., 150, 156
Comrie, E. Y., 248, 264
Conley, J. J., 149, 156
Constantini, H., 190, 197, 204, 209

- Coode, C. D., 206, 209
Cook, J. C., 148, 156
Coonrad, R. W., 290, 297
Cooper, G., Jr., 149, 156
Copeland, M. M., 24, 34
Copello, F., 92, 110
Copello, O., 147, 155
Coppinger, W. R., 57, 68
Corner, B., 19, 32
Cornil, L., 147, 155
Corradi, C., 120, 129
Corrigan, C., 5, 12
Coryn, J., 273, 281
Coste, F., 24, 33, 54, 67, 167,
 176, 180, 185, 206, 210, 235, 242
Courty, A., 189, 197
Courty, L., 28, 36
Coury, C., 24, 34
Couture, M. M., 276, 282, 295, 299
Covalt, D. A., 104, 115
Coventry, M. B., 50, 52, 260, 268
Coville, 231, 240
Craigie, J., 143, 153
Cramer, H., 174, 184
Crawford, G.N.C., 56, 68
Crawford, T., 151, 157
Creese, R., 61, 69
Creyssel, J., 176, 185
Critchley, M., 91, 110
Crosby, N. D., 83
Curnen, E. C., 77, 84
Curth, H. O., 17, 31
Curtis, A. C., 262, 268
Curtis, G. M., 46, 51
Curtis, O., 12
Czickeli, H., 23, 33
- Dal Lago, H., 170, 182
Danaraj, T. J., 102, 114
Dancis, J., 109
Dandridge, S., 1
Dane, P. G., 102, 114
D'Angio, C., J., 151, 157
Dany, A., 62, 70
Dardill, 17, 31
Darris, C., 188, 196
D'Aubigne, M., 98, 113
Davidson, B., 61, 69
Davies, P. M., 29, 36
Davies, R., 21, 32
Dean, G. O., 289, 297
Deaver, G. G., 295, 299
DeBakey, M. E., 49, 51
- DeCamp, P. T., 49, 51
Decker, P., 174, 184
DeGaetano, A., 20, 32
Dehlinger, J., 12
Dehne, E., 244, 268
DeJongh, S. E., 8, 14
Delacroix, R., 160, 163
Del Barre, F., 54, 67
Delitala, F., 133, 139, 192, 198
deMarchin, P., 17, 31
Demoulin, P., 195, 199
Denisart, P., 99, 113
Dennis, E. W., 49, 51
dePaesi, F.J.A., 14
DePalma, A. F., 123, 130
DeSeze, S., 23, 33
Desse, G., 195, 200, 254, 265
Desse, H., 261, 268
DeTarnowsky, G. O., 260, 268
Dettloff, 38, 43
Deucher, F., 195, 200
DeVidas, J., 91, 109
DeWulf, A., 7, 13, 138, 141
Diaz-Bordeu, E., 38, 42
Dick, G.W.A., 73, 82
Dickens, F., 59, 68
Diego-Caballero, A.D., 229, 239
Dittrich, R.J., 170, 182
Djian, A., 285, 296
Doeden, D., 82
Dong, L., 82
Donohue, W. L., 82
Dornan, A., 252, 265
Dreisinger, F., 290, 297
Dressler, W., 172, 183
Dripps, R. D., 63, 70
Dubois, J., 195, 199
Ducroquet, G.L., 17, 31
Dufour, P., 230, 240
Duncan, C., 148, 156
Dunlap, K., Col., 53, 71, 289, 297
Dunn, A. W., 86, 116
Dupertuis, S. M., 134, 140
DuPlay, J., 115
Durao, A., 133, 139
Durbin, F. C., 99, 113
Durieu, J., 187, 196
Dutra, F. R., 144, 153
Duvigneaud, D. G., 86
Dwyer, F. C., 253, 265
Dye, W. E., 40, 45
- Earl, A. A., 75, 82
Earle, W. R., 143, 153

- Easton, R. S., 39, 44
Eaton, J. M., 177, 185
Eaton, L. M., 109
Eberhart, H. D., 278, 283
Ebhardt, K., 38, 42
Echeverri, A. J., 39, 44
Echlin, F., 105, 16
Eckhoff, N. L. 1, 11
Eden, E., 55, 67
Edmondson, H., 57, 68
Edmunds, L. H., 293, 298
Eggers, G.W.N., 88, 108
Ekbom, K.A., 96, 112
Elder, H. M., 271, 280
Elkin, D. C., 49, 51
Elkins, E. C., 59, 69
Ellingsen, K., 89, 108
Elst, E. van der, 137, 141
Emerson, G. A., 62, 70
Emr, J., 3, 11
Ender, J., 138, 141
Engh, O. A., 169, 181
England, L. C., 38, 42
Epstein, N., 90, 109
Epstein, S., 269, 280
Erbelli, E., 38, 42
Erickson, P. T., 221, 226
Erlacher, P., 5, 12
Ernest, E.C., jr., 173, 183
Estridge, M. N., 23, 33
Eszenyi-Halasy, M., 94, 111
Etter, L. E., 64, 71
Euziere, J., 92, 110
Evans, E. M., 245, 263
Evans, F. G., 3, 11
Evans, H., 65, 71
Evans, J. A., 105, 115
Ewing, M. R., 98, 113
Ewing, P. L., 62, 70
Exner, G., 6, 13
Eyz Aguirro, C., 63, 70
- Faber, H. K., 74, 82
Fabian, F., 193, 198
Fagalde, A. E., 39, 44
Fahrni, W. H., 191, 198
Fairbank, H.A.T., 3, 12, 17, 22, 31
 32, 146, 155
Falk, W., 29, 36
Fan, K. S., 6, 13
Farengo, O., 179, 186
Fargo, W. C., 9, 15
Farina, R., 134, 140
- Farrell, R. F., 39, 43
Fatt, P., 62, 70
Fauconnier, H., 23, 33
Fay, T., 87, 108
Feinstein, B., 62, 70
Felber, R., 94, 111
Felder, D. A., 247, 263
Feldman, W. H., 40, 45
Felix, W., 159, 162
Felsenstein, F., 261, 268
Fenner, H. A., 165, 186
Ferguson, W. R., 57, 68
Ferguson, W. S., 62, 70
Fernandez-Rozas, F., 169, 181
Ferond, M., 230, 240
Ferre, R., 235, 242
Ferris, B. G., Jr., 84
Finesilver, E. M., 273, 281
Fischer, K. A., 229, 239
Fischer, W., 38, 42
Fisher, R. H., 120, 129
Fitzgerald, P. J., 151, 157
Flesch-Thebesius, M., 24, 33
Fletcher, W. B., 95, 111
Florian, M., 80, 84
Flynn, J. E., 249, 255, 264, 266
Folk, B. P., 61, 69
Fontaine, R., 62, 70
Ford, L. T., 172, 183
Forestier, J., 160, 163, 188, 196
Forrest, H. J., 6, 13
Forrester-Brown, M., 5, 12
Foti, M., 4, 12
Foulz, W. S., 86
Fowler, P. J., 255, 266
Fox, M. J., 79, 84
Fraisse, H., 34
Francillon, J., 168, 181
Francillon, M. R., 188, 196
Francon, F., 188, 196, 202, 208
 261, 268
Frantz, C. H., 88, 108
Franulovic, P., 161, 163
Fraster, F. C., 110
Fredenhagen, H., 159, 162
Freedman, B., 4, 12
Freedman, D., 93, 111
Freedman, D. A., 112
Freeman, L., 24, 34
Freund, J., 73, 82
Friberg, S., 170, 182
Fridkin, V. I., 190, 197
Friedland, F., 276, 282, 295, 299

- Friedman, A. P., 93, 111
Friedman, B., 159, 162
Friedmann, I., 148, 155
Fuchs, F., 258, 267
Furlong, R., 258, 267
Furmaier, A., 27, 35

Gainer, J. H., 40, 45
Galarcon, A. A., 2, 11
Galluccio, A.C., 229, 239
Galmiche, P., 33
Gallagher, D.J.A., 96, 112
Gama, C., 175, 184
Gambier, R., 204, 209
Garceau, G.J., 38, 42
Garcia-Calderon, J., 233, 241
Gardner, E., 202, 208, 201
Garland, H.G., 103, 115
Gasking, C.T., 166, 180
Gauger, A.R., 87, 108
Gaul, L.E., 217, 224
Gayral, B., 3, 12
Gayral, L., 93, 111
Gdalevich, I.N., 119, 129
Geckeler, E.O., 128, 131
Gegany, A.J., 54, 67
Geiger, J. C., 76, 83
Geisler, W.O., 79, 84
Gerard-Marchant, P., 39, 44
Germaine, J., 135, 140
Gersh, I., 56, 67
Gersten, J.W., 59, 68
Gervis, W.H., 255, 266
Geschickter, C.F., 57, 68
Ghersi, J.A., 235, 242
Ghormley, R.K., 206, 210, 27, 35
Gibbens, M.E., 289, 297
Gibson, A., 34, 189-197, 291, 298
Giden, F.M., 87, 108
Giles, R.G., 143, 153
Ginsberg, M., 39, 43
Giorgini, R., 166, 180
Girard, P.F., 234, 242
Giraud, G., 169, 182
Giraud, M., 255, 266
Girpwood, W., 222, 226
Gispert, C., 235, 242
Giuliani, K., 178, 186
Glander, R., 97, 112
Glas, W.W., 201-210
Glaser, K., 7, 14
Glover, J.R., 279, 284
Glover, R.P., 109

Godlewski, M., 23
Golan, H.P., 38, 42
Golden, P.B., 35
Goldie, H., 144, 153
Goldner, J.L., 249, 264
Goldner, M.G., 57, 68
Goldstein, L.A., 290, 297
Golseth, J.G., 116
Gonzal-Meneses, M.A., 3, 1b
Gonzaga de Carvalho, J., 165-186
Gonzales, F.M., 38, 42
Good, M.G., 245, 263
Goodacre, C.L., 40, 44
Goodbody, R.A., 23, 33
Goodfellow, A.M., 82-83
Goodhill, V., 144, 154
Gordon, G., 60, 69
Gordon, G.S., 62, 70
Gounaris, I.G., 230, 240
Graham, W.C., 258, 267
Gray, D.J., 201, 208
Gray, G.A., 260, 268
Grebe, A.A., 16
Greene, R., 17, 31
Greenberg, M., 75, 83
Griffiths, D.L., 190, 197
Grimes, M., 61, 69
Grimes, O.F., 272, 281
Gollman, A., 143, 153
Grone Meyer, W., 173, 183
Grosse-Brockhoff, F., 90, 109
Gruca, A., 160, 163, 41, 45
Guerin, R., 251, 265
Guerreiro, G., 286, 296
Gueur P., 131
Gruner, T., 92, 110
Guelich, W.W., 8
Guild, A.A., 93, 111
Guilleminet, M., 194, 199, 205, 209
Guitierrez, del Olmo, 285, 296
Gullickson, G., 278, 283
Gurdin, M., 257, 267
Guse, V., 230, 239
Gustilo, R.H., 173, 184
Guttman, L., 103, 115
Guyton, A.C., 79, 84
Yarmati, L., 41, 45

Haas, S.L., 176, 185, 9, 15
Hackett, L.J., Jr., 146, 154
Hadders, H.N., 145, 154
Haden, W.D.Jr., 145, 154
Hadley, L.A., 171, 182

- Hagen, R., 254, 265
Hagenmuller, D., 99, 113
Haggart, G.E., 195, 200
Hahn, P.F., 144, 153
Haimovici, H., 270, 280, 49, 52
Haines, R.S., 5, 13
Hakala, E.W., 142-153
Halborg, S.A., 119, 129
Halbstein, B.M., 191, 198
Hale, A.R., 8, 14,
Hall, C.L., 251, 264
Hall, R.M., 6, 13
Hamby, W.B., 177, 185
Hammes, E.M. Jr., 97, 112
Hammon, W., 76, 83
Hancox, N.M., 64, 71, 134, 139
Hansen, K., 25, 34
Hansen, P.B., 145, 154
Hansson, K.G., 80, 85
Harell, A., 59, 69
Hargreaves, E.R., 76, 83
Hark, F.W., 214, 223
Harmon, P.H., 189, 197, 228, 239
Harmon, P.H., 121, 129, 135, 140
Haro, S., 218, 225
Harris, G., 292, 298
Harris, H., 259, 267
Harris, L.C., 63, 70
Harris, R.F., 214, 223
Harrold, C.C., Jr., 149, 156
Hart, G.M., 7, 14
Hart, V.L., 5, 12
Hartog, B.J.C., 92, 110
Hartwich, S., 212, 223
Hathaway, E.N., 217, 224
Hauck, G.J., 190, 197
Hauser, E.D.W., 294, 299
Haussler, G., 173, 183
Haven, H., 102, 114
Haverfield, W.T., 104, 115
Hawkins, C.F., 7, 11
Hayes, W.M., 233, 241
Hays, A.T., 249, 264
Hazelrigg, T., 102, 114
Heich, T.S., 54, 67
Heilburn, N., 173, 183
Hein, G.E., 28, 35
Helket, A.J., 191, 198
Hellebrandt, F.A., 272, 281
Hembrow, C.H., 204, 209
Henderson, W.R., 154, 154
Hendry, A.M., 98, 113
Henry, M.O., 190, 197
Hepburn, H.H., 177, 186
Hepp, O., 136, 141
Herbert, J.J., 135, 140, 177, 185
Herdner, R., 38, 42
Herrmann, H., 61, 69
Hermann, J., 149, 156
Herschell, H., 167, 180, 215, 224, 214, 223
Herscher, H., 229, 239
Herzmark, M.H., 214, 223
Hess, L. 96, 112
Heusghem, C., 31
Hiddlestone, H.J.H., 152, 157
Hildreth, G., 8, 14
Hilkevitch, A., 232, 241
Hill, A.V., 60, 69
Hill, R.M., 58, 68
Hilton, G., 147, 155
Hinchey, J.J., 175, 185
Hingston, J., 20, 32
Hinshaw, H.C., 40, 44
Hipps, H.E., 288, 296, 87, 88, 89, 108
Hirsch, C., 170, 182
Hirsch, D.R., 89, 109
Hitchko, M.J., 72
Hobbiger, F., 61, 69
Hobby, G., 40, 44
Hochfeld, M., 58, 68
Hochfeld-Olliviero, J., 58, 68
Hodgkinson, R., 28, 35
Hoffmann-Kuhnt, H., 214, 223
Holbourn, A.H.S., 60, 69
Holbrook, T.J., 66, 71
Holstein, A., 218, 225
Holt, R.P., 165-186
Homan, R., 57, 68
Horanyi, J., 195, 200
Hornberger, E.Z. Jr., 78, 84
Horstmann, D.M., 77, 84
Horwitz, T., 133, 139
Hosford, J., 218, 225
Howard, L.D. Jr., 256, 266, 259, 267, 293-298
Howard, R.P., 25, 34
Howard, W.D. 39, 43
Howell, B.W., 249, 264
Howells, G.H., 148, 155
Howell, T.H., 231, 241
Howes, E.L., 54, 67
Huard, P., 227, 239
Huberg, 38, 43
Huddleston, O.L., 85, 106, 116
Hudson, F.P., 99, 113
Hudson, O.C., 219, 225
Hughes, N.C., 259, 267
Hull, D., 244-268
Hultquist, G., 171, 182

- Hurlburt, H.S., 74, 82
Hurst, A., 40, 45
Hutter, C.C., 148, 155
Hutter, C.G., 6, 13
Hutton, S.B., 49, 51
Huwyler, J., 39, 44, 136, 141
Hyatt, G.W., 135, 140
Hyland, H.H., 92, 110
- Ibister, J., 234, 242
Ihlenfeldt, G., 27, 35
Inberg, K.R., 175, 184
Ingeirans, P., 178, 186, 5, 13
Ironside, R., 103, 115
Irving, J.T., 9, 15
Irwin, C.E., 249, 264
Iselin, M., 250, 264
Ivker, M., 151, 157
Ivsevich, I.S., 159, 162
Ivy, A.C., 58, 68
- Jackson, A.E., 147, 155
Jackson, Burrows, H., 287, 296
Jacobs, B.J., 57, 68
Jacobs, J.E., 91, 109
Jacobi, H.P., 62, 70
Jacobson, W.E., 144, 154
Jaeger, F., 173, 183
Jahss, M.H., 86
Jalavisto, E., 277, 283
James, J.I.P., 134, 139, 252, 265
James, O.E., jr., 148, 155
Jampol, H., 230, 239
James, J.M., 9, 15
Jarcho, L.W., 63, 70
Jaros, K., 161, 163
Jaros, M., 212, 211, 223
Jeanopoulos, C.L., 204, 209
Jefferson, N.C., 39, 43
Jenkins, S.A., 256, 266
Jenny, F., 271, 280
Jens, J., 230, 240
Jensen, W.P., 106, 116
Jentzer, A., 2, 11
Jepson, R.P., 255, 266
Jessop, W.J.E., 9, 15
Johann, K., 278, 283
Johnson, D.F., 145, 154
Johnson, H.F., 119, 129
Johnston, J.H., jr., 105, 116
Joldersma, R.D., 218, 225
Joly, L., 261, 268
Jones, E.M., 39, 43
- Jones, G.B., 216, 224
Jordan, J., 97, 112
Joseph, J., 259, 267
Judet, J., Judet, R., 194, 199, 136, 140
- Kabat, E.A., 95, 112
Kaell, H.I., 146, 155
Kallio, K.E., 274, 282
Karlson, A.G., 40, 45
Karpinski, F.E. jr., 148, 156
Kastert, J., 252, 265
Katz, B., 60, 69-90-109
Katz, M., 90, 109
Kay, J.M., 49, 51
Kayser, C., 62, 70
Keedy, C., 104, 115
Keevil, J.J., 272, 281
Keith, A., 134, 139
Keizer, D.P.R., 92, 110
Kelikian, H., 203, 208
Kellecher, W.H., 77, 84
Kelleher, J.J., 131
Kelley, V.C., 75, 82
Kemp, A., 175, 184
Kendair, E.C., 54, 67
Kendall, D., 248, 264
Kerneis, J.P., 25, 34
Kessel, A.W.L., 228, 239
Kessel, J.F., 73, 82
Kessler, H.H., 279, 284
Ketelslegers, J., 23, 33
Key, J.A., 172, 173, 183, 174, 184
Khoo, F.Y., 39, 43
Kiaer, S., 277, 283
Kiefer, E.J., 160, 163
Kierule, E., 17, 31
Kiesselbach, A., 274, 282
Kilby, W.L., 20, 32
Kilfoyle, R.M., 126, 131
Kiloh, L.G., 98, 113
Kimberley, R.C., 48, 51
Kindred, R.G., 86
King, D., 189, 197
Kini, M.G., 193, 199
Kirkaldy-Willis, W.H., 192, 198
Kirkman, L.W., 262, 268
Kirsch, J., 136, 140
Kissel, P., 101, 114, 106, 116
Kite, J.H., 213, 223
Klein, M., 62, 70
Klein, R., 15
Kleinberg, S., 166, 180, 166, 180 167, 181
Klima, M., 237, 243

- Klopper, F., 188, 196
Klovstadt, O., 97, 112
Knauer, G.J., 72 - 85
Kniedel, J.H., 38, 43
Knowles, D.D., 82
Knud-Hansen, J.I.F., 86 - 116
Knutson, F., 160, 162
Koch, W.E., Jr., 23, 33
Kodicek, E., 65, 67
Kohler, L.M., 21, 32
Kolb, L.C., 276, 283
Kole, W., 123, 130
Koletsky, S., 143, 153
Kooda, J.C., 189, 297
Koontz, A.R., 48, 51
Konar, N.R., 261, 268
Kostler, O.C., 257, 266
Kottke, F.J., 278, 283
Kovacs, A., 171, 182
Kozhevnikov, P.V., 17, 31
Kozla, M.M., 39, 43
Kraft, G.L., 147, 155
Krainin, P., 151, 157
Kramer, W., 172, 183
Krauss, H., 28, 35
Kraus, S.D., 54, 67
Krayenbuhl, H., 177, 186
Kroll, F.W., 173, 184
Krueger, F.J., 128, 131
Kugelberg, E., 59, 69, 175, 184
Kuhlendahl, H., 171, 182
Kuhnen, J.C., 292, 298
Kuhns, J.G., 204, 209
Kulowski, J., 148, 156
Kung, Z., 100, 114
Kurt, H., 190, 198
Kutz, E.R., 39, 44
Kwalwasser, S., 159, 162
Kynaston, R.U.F., 26, 34
- Lachapelle, A.P., 21, 32
Laduron, E., 232, 241
Lafaury, A., 250, 264
Lafferty, J.O., 152, 157
Lagunova, I.G., 190, 197
Lake, N.C., 211, 223
Lam, C.R., 47, 51
Lance, 159, 162
Landa-Bacallo, M.A., 229, 239
Lande, 2, 11
Landry, B.B., 47, 51
Langenskiold, A., 262, 268
Langeron, L., 161, 163
- Langevin, R., 231, 240
Lapidus, P.W., 221, 226
Laporte, J., 40, 45
Laprade, C., 30, 36
Large, A., 270, 280
Largent, E.J., 144, 153
Larghero-Ybarz, P., 133, 241
Larkin, V.D.P., 22, 32
Lasserre, C., 23, 33, 254, 266
Lauge-Hansen, N., 127, 131
Laur, A., 21, 32
Lautre, M.A., 105, 116
Lauwens, J., 131
Lavedan, J., 151, 157
Lawless, E.C., 147, 155
Lawson, R.W., 273, 281
Layton, L.L., 143, 153
Leatherman, K.D., 229, 239
Lebsche, M., 274, 281
Lecocq, E.A., 133, 139
Lecocq, J.F., 133, 139
Lecutia, T., 148, 156
Legge, R.F., 46
Leger, L., 176, 283
Lehmann-Faciis, H., 173, 183
Lehner, A., 177, 186
Lehoczky, T. von, 94, 111, 100 114
Leinwand, I., 247, 263
Le Lievre, J., 218, 225
Lemaitre, G., 28, 36
Lenert, T., 40, 44
Lenhard, R.E., 81, 85
Leonhard, M., 287, 296
Lepine, E., 231, 240
Lequesne, L.P., 273, 281
Leriche, R., 24, 33, 276, 282
Leroux, R., 25, 34
Lesem, A.M., 83
Lester, C.W., 3, 12
Leventhal, G.S., 124, 130
Levin, I.M., 100, 113
Levine, M.A., 247, 263
Levin, M.L., 87, 108
Levinthal, D.H., 147, 155
Levernieux, J., 159, 162
Levy, B., 292, 298
Lewin, N., 39, 43
Lewin, P.M., 89, 109
Lewis, G.K., 47, 51
Lewis, K.M., 122, 130
Lewis, R.A., 10, 15
Lewis, R.B., 216, 224
Leyette, M. de la, 98, 109

- Licht, S., 50, 52
Lichstein, H.C., 56, 67
Lichtenstein, B.W., 146, 154
Liebolt, F.L., 189-196, 257, 267
Liefoghe, J., 161, 163
Liesch, E., 160, 163
Lievre, J.A., 23, 33, 234, 242
Liljenthal, J.L., jr., 61, 63, 69, 70
Limburg, C.C., 94, 111
Lindblom, K., 171, 182
Lino, D.B., 245, 263
Linton, R.L., 247, 263
Lipin, R.J., 39, 43
Lippman, E.M., 253, 265
Lipton, M.M., 73, 82
Logan, W.P.D., 76, 83
Lohe, R., 207, 210
Longmore, T.A., 172, 183
Lopez-Vallejo, J., 37, 42
Loreti, F., 63, 70
Loseff, H., 287, 296
Love, J.G., 160, 163
Lovell, W.W., 213, 223
Lowry, K.F., 46, 51
Lugiato, P., 132, 139
Lukanov, A.T., 41, 45
Luskin, R., 86
Lux, H., 28, 36
- Mc Bride, E.D., 293, 298
Mc Burney, H.S., Col., 38, 42, 285, 299
Mc Candless, A., 113
Mc Carroll, H.R., 137, 141
Mc Comas, E., 41, 45, 217, 224
Mc Conville, B.E., 205, 209, 273, 281
Mc Coy, F.J., 276, 282
Mc Dermott, L.J., 253, 265
Mc Donald, R., 91, 109
Mc Dowell, I., 236, 243
Mc Laughlin, C.W. jr., 270, 280
Mc Lean, F.C., 50, 52
Mc Murrin, J.A., 65, 71
Mc Phee, H.R., 220, 226
Mc Pherson, A.G., 23, 33
- Maass Patino, J., 121, 129
Maccarty, C.S., 104, 115
Mac Conaill, M.A., 64, 71
Mac Donald, D., 275, 282
Mac Dougall, J.T., 27, 34
Mac Gregor, M., 21, 32
Mach, F., 133, 139
Macht, S.H., 39, 44
- Mackay, R.P., 94, 111
Macomber, W.B., 257, 267
Magee, M.C., 83
Magill, H.K., 293, 298
Magill, R.K., 131
Magladery, J.W., 61, 69
Magnusson, R., 205, 209
Maier, E.R., 165 - 186
Makhlof, A., 133, 139
Malaguzzi, V.C., 179, 186
Malinowsky, L., 279, 284
Mallows, H.R., 4, 12
Maloney, J.V., jr., 84
Malzberg, B., 87, 108
Mangini, G., 174, 184, 272-281
Mannino, R., 65, 71
Manzanilla, M.A., jr., 105, 116
Marchal, G.,
Marchand, J.C.A., 124, 130
Marconi, S., 203, 208
Marcovci, N., 237, 243
Marcozzi, G., 28, 35
Margoliash, E., 55, 67
Margules-Lavergne, M.P., 115
Mari Nacci, A.A., 116
Marino-Zuco, C., 39, 44
Marique, P., 169, 181
Maroger, B., 97, 112
Marshall, C.S., 110
Martelli, F., 95, 111
Martens, E., 39, 43
Martin, B.C., 47, 51
Martin, E., 135, 140
Martin, G.M., 59, 68-69
Martin, H.E., 57, 68
Martin, J.F., 148, 156
Marx, C., 62, 70
Mascarenhas, G., 2, 11
Mason, H.L., 54, 67
Mason, M.L., 48, 51
Mathieson, D.R., 54, 67
Matusewicz, J., 28, 35
Mau, C., 103, 115
Maurer, H.J., 188, 196
Mautner, H., 1, 4, 11, 12
Maxwell, G.S., 120, 129
Mayerhofer, E., 92, 110
Mayoral, A., 221, 226
Mayr, S., 176, 185
Mead, S., 59, 69
Medbo, I.U., 187 - 200
Meier-Stauffer, G., 215, 224
Meirowsky, A.M., 102, 114

- Meissner, J.P., 278, 283
Neites, J., 55, 67
Melnick, J.L., 84
Mendlowitz, M., 213, 223
Menegaux, G., 190 198
Merckelbach, F.M.L., 175, 185
Meredith, J.M., 146, 155
Mendino, K.A., 272, 281
Meriwether, T.W., 165-186
Merle, P., 99, 113, 171, 182
Merle-D'aubigne, R., 189-197, 193-194-199,
 258, 267
Merritt, L.E., 217, 224
Metcalfe, D.C., 110
Meurer, H., 92, 110
Meyer, P.S., 219, 225
Meyer, S.W., 256, 266
Meyerding, H., 142, 153
Meyerding, H.W., 147, 155, 287, 296
Meyer-Laack, H., 105, 116
Michele, A.A., 128, 131, 254, 266
Michaelis, L.S., 231, 240
Michael, J., 88, 108
Michotte, L.J., 206, 210
Milch, H., 137, 141, 191, 198, 232, 241
Miller, G.F., 93, 111
Miller, H.C., 1, 11
Miller, H.I., 93, 111
Miller, J.M., 39, 43
Miller, L.F., 123, 130, 232, 241
Miller, R.J., 165-186
Millner, T., 40, 45
Mills, C.A., 8, 14
Mills, S.D., 83
Milman, D.H., 8
Minet, J., 254, 265
Minot, A.S., 61, 69
Mitbreit, I.M., 217, 224
Mitchell, J.R., 64, 71
Mitchesll-Heggs, G.B., 218, 225
Mithoefer, J., 259, 267
Moffatt, A.A., 207, 210
Monnier, J., 40, 45
Monro, P.A.G., 105, 116
Montagne, M., 227, 239
Moore, D.C., 293, 298
Moore, F.T., 259, 267
Moorehead, S.F., 165-186
Moraes, F.D., 246, 263
Morgulis, S., 62, 70
Morrica, M., 20, 32
Morrin, F.J., 178, 186
Morsier, D., 233, 241
Morton, H. S., 244, 263
Moser, H., 137, 141, 274, 282
Moskopp, M.E., 279, 284
Mueller, F., 59, 69
Muller, G.M., 255, 266, 291-197
Muller, K.L., 161, 163
Munaged, 104, 115
Munslow, R.A., 175, 185
Murphy, J.W., 40, 44
Murphy, W., 23, 33
Murray, P.D.F., 56, 67
Musgrove, J.E., 9, 15
Mushin, W.W., 63, 70
Mustard, W.T., 84
Naber, H.G.A., 271, 280
Nagel, L.C., 188, 196
Naidu, I.C., 193, 199
Nardell, S.G., 16, 31
Nash, C.C., 73, 183
Nassim, J.R., 151, 157
Nathanson, L., 232, 241
Naylor, A., 276, 282
Nelson, M.M., 65, 71
Nelson, T.F., 195, 200
Neuhäuser, E.B.D., 4, 12
Neustadt, E., 204, 209
Newman, B.A., 18, 31
Newman, M.K., 104, 115
Nicholas, J.S., 61, 69
Nicholson, C., 166, 180
Niebauer, J.J.,
Nissen, K.I., 4, 12
Nissl, R., 219, 226
Nixon, J.W., 144, 154
Noback, C.R., 9, 15
Nolan, J.O., 47, 51
Novak, P., 127, 283
Nowicki, V., 115
Nuessle, R.F., 219, 225
Nutritional Reviews, 9, 15
Oberhill. H.R., 145, 154
Obrien, R.M., 46, 51
Ochsner, A., 49, 51
O' Connell, J.E.A., 177, 186
O' Connell. J.G., 122, 130
O' Donnel. M.B., 108

- Oehlecker, F., 38, 42
Oginsky, E.L., 40, 44
Oliver, D.R., 133, 139
Olivier, G., 217, 224
Olsen, A.K., 177, 185
O'Malley, A.G., 113
O'Meara, J.W., 118, 129
Oosthuizen, S.F., 260, 268
Ordoneau, P., 23, 33
Osborne, G.V., 191, 198
Osmond-Clarke, H., 212, 223
Otermin-Aguirre, J.A., 41, 45
Ottolenghi, C.E., 218, 225
Overbeek, V.J., v.d., 107, 116
Overton, L.M., 235, 242
- Pack, G.T., 149, 156, 159, 162
Padovani, P., 168, 181
Paff, G.H., 65, 71
Pages, P., 110
Paillas, J.E., 104, 115
Paillot, J., 135, 140, 260-268
Pais, C., 192, 198
Pait, C.R., 73, 82
Paley, S.S., 101, 114
Palmer, H., 96, 112
Palmer, J.M., 39, 43
Palmer, K.W.N., 98, 113
Palumbo, L.T., 230, 240
Palun, J., 23, 33
Pangman, W.J., 257, 267
Paoletti, A., 40, 45
Pariente, R., 65, 71
Parkinson, J.L., 60, 69
Parmelee, A.H., 14
Parnes, I.H., 150, 156
Parrish, F.T., 217, 224
Patino, M.J., 121, 129
Patterson, C.E., 173, 183
Patterson, R.L. jr., 217, 224
Paul, L., 168, 181
Paul, M.A., 288, 297
Pauwels, F., 27, 35
Pearson, C.M., 151, 157
Pease, C.N., 26, 34
Pecker, J., 96, 112
Pedersen, H.E., 202, 208
Peikoff, S.S., 236, 243
Pendergrass, E.P., 152, 157
Peresson, A., 274, 282
Perey, K., 278, 283
- Perkoff, G.T., 91, 110
Perles, L., 188, 196
Perlstein, M.A., 88, 108
Perrot, A., 169, 181
Perroy, A., 170, 182
Perry, J.F., jr., 144, 154
Perry, S.P., 145, 154
Petersen, I., 59, 69, 175, 184
Petr, R., 189, 197
Perusi, A., 160, 162
Peterson, L.T., 123, 124, 130
Pettko, E., 62, 70
Peyser, D., 90, 109
Phalen, G.S., 166-180, 247, 264
Philip, W.M., 237, 243
Phillips, C.G., 60, 69,
Phillips, C. W., 39, 43
Phillips, J.M., 152, 157
Piazza, A., 21, 32
Picaud, A., 168, 181
Pietra, A.D., 39, 43
Pike, M.N., 26, 34
Pilcher, C., 66, 71
Pipkin, G., 205, 209
Pirani, C.L., 56, 67
Pitney, W.R., 148, 156
Pitzén, P., 212, 223
Pique, J.A., 126, 131
Plattner, E.B., 14
Platou, E., 5, 13
Plotz, C.M., 54, 67
Polak, M., 145, 154
Polivka, D., 218, 225
Polley, H.F., 54, 67
Ponseti, I.V., 159, 162
Poppen, J.L., 237, 243
Porot, J., 21, 32
Popovici, A., 57, 68
Pototschnig, H., 167, 180
Potter, T.A., 204, 209
Potvin, H., 278, 284
Potvin, J., 278, 284
Poucel, J., 168, 181
Poulsen, T., 58, 68
Power, M.H., 54, 67
Pratt, G.M., 49
Pratt, W.A., 218, 225
Pretl, K., 29, 36
Prevo, S.B., 149, 156
Price, E.E., 202, 208
Prick, J.J. G., 95, 111

- Priessnitz, O., 170, 182
Prochazka, J., 206, 210
Profitt, J.N., 145, 154
Pruvot, G., 206, 209
Provenzale, L., 65, 71
Pudenz, R.H., 235, 242
Pujo, D.M., 27, 35
Purves, R.K., 238, 243
Pulvermacher, I., 215, 224
Pulvertaft, R.G., 250, 264

Quirin, L.D., 230, 240

Raagaard, O.V., 277, 283
Rackow, O.W., 220, 226
Rader, D., 73, 82
Rafel, S.S., 57, 68
Ralston, H.J., 62, 70
Raney, A.A., 235, 242
Raney, R.B., 235, 242
Ransohoff, N.S., 78-84, 159, 162
Rathcke, L., 189, 197
Ravault, P., 26, 34
Ravault, P.P., 167, 180
Reavis, J.C., 28, 35
Redisch, W., 219, 225
Reeder, O.S., 117-131, 125, 130
Reeder, R.C., 79, 84
Regele, H.B., 271, 280
Regna, P., 40, 44
Reifen, D., 279, 284
Relly, W.A., 79, 84
Reinovsky, A., 57, 68
Reiss, E., 173, 184
Remouchamps, L., 97, 112
Ren, G., de, 116
Rene, L., 230, 240
Reymond, J.C., 189, 196, 230, 240,
 232, 241-246-263
Reynolds, F.C., 133, 139
Reynolds, E.L., 65, 71
Rhodes, A.J., 74, 82
Ricard, A., 168, 181, 194, 199
 234, 242, 176, 185
Rice, M.L., jr., 102, 114
Richardson, J.L., 6, 13, 7, 13
Rider, J.A., 91, 109
Rieunau, G., 124, 130
Ritchie, A.M., 82
Ritter, J.A., 90, 109

Rizzoli, H.V., 235, 242
Robbins, W.J., 7, 14
Roberts, L.V., 23, 33
Roberts, M.A., 130
Robertson, R.L., 49, 51
Robichon, J.G., 187, 200
Robinson, D., 229, 239
Robinson, F., 115
Robinson, R.A., 273, 281
Robinsin, R.H.O.B., 146, 155
Robson, M., 287, 296
Roca, C.A., 221, 226
Roche, M.B., 120, 129, 166, 180
Rochet, P., 127, 131
Rodriguez, P.J., 40, 45
Roederer, C., 6, 13
Roederer, T.R., 160, 162
Roemer, F.J., 122, 130
Roger, H., 96, 112
Rogers, H.G., 64, 70
Rogers, H.J., 64, 70
Rokta, M., 17, 31
Roldan, C.R., 39, 43
Roller, Z.V., 38, 42
Ronnen, J.R., 167, 180
Rook, A.J., 17, 31
Rose, G.K., 160, 163
Rosenblatt, S., 62, 70
Rosenstein, P., 258, 267
Rosin, I.E., 16
Rossiter, R.J., 100, 114
Rotes-Querol, J., 161, 163
Rouhier, G., 251, 264
Rounds, R.c., 72-85
Rountree, T., 248, 264
Rousseau, P., 22, 32
Rousseaux, P., 116
Rowe, C.G., 166, 180, 194, 199
Rowe, C.R., 205, 209
Rubenstein, B., 109
Rubin, J.S., 229, 239
Rubin, L.R., 257, 267
Rubin, M., 57, 68
Rucker, H., 231, 240
Rudolph, H., 293, 298
Rummelhardt, S., 260, 268
Rushforth, A.F., 3, 12
Russell, L.W., 145, 154, 152, 157
Russell, T.B., 252, 265
Russell, W.R., 275, 282

- Russo, P.E., 150, 156
Ruta, M.I., 246, 263
Ruther, H., 218, 225
Rutledge, E.K., 58, 68
Rylander, C.M., 211-226
- Sachar, L., 119, 129
Sagastume, J.M., 237, 243
Saha, A.K., 219, 226
Sahs, A.L., 95, 111
Saigh, R., 78, 84
Saint, C.F.M., 234, 241
Saint, J.H., 272, 281
Saint-Marc, 188, 196
Salasc, J., 121, 129
Salembier, 220, 226
Salmon, 193, 194, 199
Salvaing, J., 25, 34
Samitier, J., 40, 45
Samuel, E.P., 256, 266
Sangiovani, A., 38, 42
Santacroce, A., 18, 31
Santanelli, L., 271, 280
Sanz, J.M., 161, 163
Sarasin, R., 233, 241
Sarlin, L., 206, 210
Sarnoff, L.C., 84
Sarnoff, S.J., 80, 84
Sarroste, J., 137, 141
Sarpener, M.A., 203, 208
Satanowsky, S., 203, 208
Saxl, A., 187, 196
Scales, J., 292, 298
Scarfi, G., 204, 209
Schacter, M., 93, 96, 111, 112
Schaffee, W., 161, 163
Schajowicz, F., 145, 154
Schalle, H., 37, 42
Schapiro, S., 195, 200
Schaubel, H.J., 167, 181
Scheibert, C.D., 102, 114
Scheidt, R., 124, 130
Scheller, H., 176, 185
Schenken, J.R., 146, 155
Scherrer, J., 111
Schilling, E.L., 143, 153
Schlenk, F., 62, 70
Schmitz, K.E., 278, 283
Schneeburg, N.G., 23, 33
Scholder, J.C., 6, 13
Scholer, G., 173, 184
- Schrey, E.L., 206, 210
Schuler, F.B., 195, 200
Schultz, A.H., 195, 199
Schultz, E.C., 235, 242
Schultz, W.M., 269, 280
Schulz, B.F., 292, 298
Schumacher, G.A., 94, 111
Schwartz, A.A., 121, 129
Schwensen, C., 99, 113
Sciarra, D., 94, 111
Scobey, R.R., 72, 82
Scott, R.B., 2, 11
Scott, W., 6, 13
Scougall, S.H., 167, 181
Scoville, W., 294, 298
Scuderi, C., 206, 210
Secher, O., 58, 68
Seddon, H.J., 245, 263
Segal, S., 12
Seghini, G., 38, 42
Seidenstein, H., 221-226, 252, 265
Seigman, E.L., 20, 32
Seifter, J., 54, 65, 67, 71
Sellers, D., 244-268
Sellers, K.C., 55, 67
Semmes, R.E., 235, 242
Sepich, M.J., 237, 243
Seree, 38, 43
Seymour, D.E., 40, 44
Seze, S.D., 171-172, 182-183, 187-196,
230, 239, 240, 286-296
Seze, S., de, 159, 162
Shaw, E.W., 84
Shea, P.A., 290, 297
Shear, H.R., 294, 298
Sheehan, F.T., 236, 242
Sheehan, J.E., 291, 298
Shelden, C.H., 235, 242
Shelton, E., 143, 153
Shepard, R.H., 8, 14
Sherman, R.S., 151, 157
Sherman, M.S., 25, 34
Shimada, F., 82
Shimonek, S.W., 27, 35
Shinners, 177, 185
Sholl, D.A., 14
Shorbe, H.B., 293, 298
Shulman, S., 190, 197
Sicard, A., 133, 135, 139, 140, 166, 180,
Siffert, R.S., 27, 35
Siffre, J., 135, 140

- Siegel, M., 83
Siehl, D., 173, 183
Siemens, W., 279, 284
Silberberg, M., 8, 14
Silberberg, R., 8, 14
Silbert, S., 270, 280
Siler, V.E., 249, 264
Sillevis, S.W.G., 237, 243
Silverberg, R.J., 82
Silverthorne, N., 75, 83
Simeone, F.A., 247, 263
Simkovic, I., 277, 283
Simpson, T.R., 221, 226
Simon, N., 159, 160, 162
Sinigaglia, D., 28, 36
Sinnige, J.L.M., 92, 110
Siska, K., 192, 198
Sissons, H.A., 285, 296
Sitterley, J.L., 38, 42
Skarenborg, H., 204, 209
Skrygin, V.P., 159, 162
Sloan, J., 279, 284
Slobodkin, M., 232, 241
Slocumb, C.H., 54, 67
Smelin, A., 151, 157
Smirnova, L.A., 275, 282
Smith, A.D., 39, 43
Smith, F.M., 121, 129
Smith, H., 125, 130
Smith, H.G., 271, 280
Smith, L.A., 38, 43
Smith, O.E., 2, 11
Smith, P.H., 40, 44
Smith, R.G., 49, 51
Sobel, A., 253, 265
Sobel, P., 253, 265
Sohier, 231, 240
Sohier, P.T., 99, 113
Solnitzky, O., 98, 113
Somerville-Large, C., 219, 225
Sonnenchein, R.R., 58, 68
Sonnenchein, V., 106, 116
Sorge, W., 38, 42
Sorrel, E., 261, 268
Sooza-Diaz, A.G., 39, 43
Soule, A.B., jr., 102, 114
Soule, E.H., 83
Southcott, R.V., 76, 83
Spalding, J.M.K., 275, 282
Spencer, H.A.; 146, 155
Spinola, N., 120, 129
Spira, E., 279, 284
Spiroff, B.E.N., 58, 68
Spittler, A.W., 10, 15, 269, 284
Spotorno, A., 7, 13
Sprague, R.G., 54, 67
Spray, P.E., 206, 210
Sprengel, H., 270, 280
Sporling, R.G., 98, 112
Stamm, T.T., 213, 223
Stapelmohr, S., von, 232, 241
States, J.D., 165, 186
Stearns, G., 55, 67
Stecklemacher, S.A., 101, 114
Steinberg, S.H., 22, 32
Steinberg, G., 257, 267
Stenger, E., 230, 239
Stenhouse, N.S., 83
Stephens, F.E., 17, 31
Stevenson, C.A., 86, 116
Stevenson, G.H., 277, 283
Stevenson, T.W., 144, 154
Stewart, J.E., 289, 297
Stewart, M.J., 148, 155
Stiff, D.W.S., 102, 114
Stimson, P.M., 78, 84
Stinchfield, F.E., 192, 198
Stol, J., 6, 13
Stone, M.A., 137, 141
Stone, S., 78, 84
Stonehill, T., 236, 242
Storck, H., 5, 15
Stortebecker, T.P., 89, 109
Stovall, S.L., 119, 129
Stow, R.M., 40, 44
Stracker, O., 137, 141
Strang, C., 29, 36
Strassburger, P., 222, 226
Straub, F.B., 62, 70
Straub, L.R., 84
Strayer, L.M., jr., 127, 131
Street, D.M., 125, 130
Stricker, P., 28, 36
Strong, J.M., 167, 181
Strong, W.R., 86
Stuart, F.W., 160, 163
Stucke, K., 219, 225
Stuck, W.G., 190, 198
Sturzenegger, H., 166, 180
Suarez-Pupo, J., 147, 155
Sullivan, R.F., 253, 265
Sulon, E., 65, 71

- Sutherland, J.M., 95, 111
Sutherland, K., 56, 67
Swanker, W.A., 291, 298
Swynghedaus, 220, 226
Szabolcz, Z., 271, 280
Sztaba, R., 37, 42
- Talbot, S., 99, 113
Talbot, S.A., 63, 70
Tamalet, J., 170, 182
Tansella, G., 91, 110
Tanz, S.S., 165, 180
Tapie, J., 40, 45
Tarrant, R.M., 232, 241
Taylor, D.V., 28, 36
Taylor, F.W., 48, 51
Taylor, L.W., 158, 164
Taylor, R.G., 191, 198
Telford, K.M., 161, 164
Teloh, H.A., 48, 51
Teneff, S., 291, 297
Terry, R.A., 62, 70
Teschendorf, R., 4, 12
Thatcher, H.V.H., 250, 264
Thatcher, H.V., 227, 239
Thelander, H.E., 27, 35
Thibaudeau, R., 90, 109
Thiele, G.H., 195, 200
Thomas, A., 103, 115
Thomas, D.F., 252, 265
Thomas, L.I., 80, 84
Thomas, W.W.P., 17, 31
Thompson, C.E., 102, 114
Thompson, F.R., 231, 240
Thompson, T.C., 84
Thomsen, W., 190, 197
Thomson, G.R., 260, 268
Thorndike, A., 278, 283
Thygesen, P., 88, 108
Tillotson, J.F., 50, 52
Timme, W., 96, 112
Tinazzi, F.P., 236, 243
Tirman, R.M., 165, 186
Tohen-Zamudio, A., 89, 109
Toumey, J., 136, 140
Toumey, J.W., 134, 139, 178, 186
Tourneux, M.J.P., 119, 129
Townley, C.O., 230, 240
Tremblay, G.O., 39, 44
Trevor, D., 215, 224
- Trouchet, P., 136, 140
Truhlar, J., 61, 69
Tschanne, F., 106, 116
Tucker, W.E., 256, 266
Tufo, G.F., 168, 181
Turkish, M., 40, 44
Turnbull, G.M., 217, 224
Turrettini, A., 3, 12
Tyler, F.H., 17, 31, 91, 110
Typovsky, K., 218, 224, 232, 241
- Ude, W.H., 20, 32
Uiberall, E., 97, 112
Umbreit, W.W., 40, 44
Underwood, G.B., 217, 224
Ungley, C.C., 101, 114
Unkauf, B.M., 228, 239
Upshaw, J.E., 150, 156
Urrist, M.R., 50, 52
- Vaeye, J., 27, 34
Valls, J., 145, 154
van Creveld, S., 19, 32
Vandenberg, H.J.J., 143, 153
Van Denmark, R.E., 159, 162
Van Der Elst, E., 137, 141
Van de Voorde, C., 126, 131, 138, 141
 219, 225
Van Dyke, N.M., 294, 298
Van Hove, R., 124, 130
Van Lerenberghe, J., 5, 13
Van Ness, C.P., 274, 282
Van Wageningen, G., 9, 15
Vare, V.B., 227, 243
Vargues, R., 115
Vaughan-Jackson, O.J., 254, 265
Vecchione, P., 128, 131
Velasco-Zimbrow, A., 133, 139
Vera, A.R., 170, 182
Veebeek, A.D.J., 136, 140
Verbeke, R., 97, 112
Verbiest, H., 106, 116
Verbrugge, J., 27, 35
Verdejo, Y., 161, 163
Vereecken, E., 138, 141
Vernet, 38, 43
Vergoz, 252, 265
Vignon, G., 34
Vittori, M., 255, 266
Vizoso, A., 14

- Vleek, J., 166, 180
Vogel, E., 78, 84
Volpe, L., 270, 280
Von Lackum, W., 288, 296
Von Ronnen, J.F., 245, 263
Von Ronnen, J.R., 214, 223
Voorde, C., van der, 138, 141
Vosgian, M.E., 61, 69
Vosschulte, K., 171, 182
- Wachsmuth, G., 64, 70
Wahren, H., 136, 140
Wainwright, W.W., 65, 71
Waisman, R.C., 203, 208
Wakim, K.G., 59, 68, 69
Walch, A., 27, 35
Walker, A.E., 173, 184
Walker, J.R., 86
Walker, W., 129
Wallach, E.A., 2, 11
Wallace, P., 138, 141
Walters, B., 286, 296
Walton, R.J., 143, 153
Ward, R.S., 109
Ward, R., 73, 77, 82, 83
Warrick, C.K., 228, 239
Washburn, A.H., 7, 14
Waters, G., 98, 108
Watson-Jones, R., 248, 264
Watterson, R.L., 58, 68
Waugh, O.S., 177, 186
Waugh, R.L., 253, 265
Weber, L.A., 246, 263
Wedin, P.H., 238, 243
Wegman, M.E., 76, 83
Weidmann, S., 64, 70
Weil, S., 41, 45, 192, 198
Weill, J., 90, 109
Weiner, H.A., 271, 280
Weintraub, S., 54, 67
Weiser, O.L., 40, 45
Weisman, S.J., 90, 91, 109
Weiss, R.M., 9, 15
Weissenbach, R.J., 202, 208
Welch, C.E., 247, 263
Welte, E., 90, 109
Wentholt, H.W.M., 145, 154
Wenzl, M., 260, 268
Werssowetz, O.F., 279, 284
Wertheimer, P., 237, 243, 270, 280
Wetzel, N.C., 9, 15
- Wheelock, M.C., 48, 51
White, M.I., 101, 114
Whittenberger, J.L., 85
Whittico, J., 129
Wiberg, G., 171, 182
Wiedman, J.G., 270, 280
Wieringen, F., van, 14
Wiggins, H.E., 227, 243
Wilde, C.E., Jr., 8, 14
Wilder, V.M., 62, 70
Wilkins, L., 15
Williams, T.H., 34
Wilson, F.H., 82
Wilson, G.E., 127, 131
Wilson, J.N., 178, 186
Wilson, M.J., 150, 156
Winant, E.M., 211, 223, 231, 240
Winston, B.J., 276, 282
Wiswell, G.B., 93, 110
Wittenborge, M.H., 12
Wolf, J., 206, 210
Wolfson, W.Q., 109
Wolin, I., 221, 226
Wood, J.P., 174, 184
Wooding, C.H., jr., 2, 11
Woodland, L.J., 18, 31
Woolner, L.B., 260, 268
Wright, L.T., 54, 67
Wustmann, O., 246, 263
Wycis, H., 176, 185
- Yamshon, L.J., 115, 294, 298
Yancey, A.G., 273, 281
Ybarz, P., 178, 186, 233, 241
Yoss, R.E., 96, 112
Youchnovetzki, 103, 115
Young, J.H., 167, 181, 175, 185
Yu, H.I.S., 39, 43
- Zabokrzycki, J., 160, 163
Zadek, I., 178, 186
Zamecnik, P.C., 7, 14
Zarzecki, C.A., 150, 156
Zatman, L.J., 59, 68
Zierler, K.L., 61, 69
Zifroni, A., 40, 45
Zimbron, A.V., 139
Zingoni, U., 60, 69
Zippermann, H.H., 48, 51
Zoltan, L., 173, 184
Zweighaft, J.F.B., 103, 115

SUBJECT INDEX

- A -

- Absence, congenital, ilium, 195
Absorbability of hemostatic agents, 57
Acetabulum, fracture, 190
Acetanilide, 58
Acetylcholine, 61-63
 in myasthenia, 90
Achondroplasia, 17
Aclasis, tarso-epiphyseal, 215
Acromioclavicular joint, 232
Acromion, pseudarthrosis, 218
Acroparaesthesia, 245
Acrylic prosthesis in spine fusion, 136
ACTH, conference, 54
 in myasthenia, 90
Acute leukemia, 148
Adactar in myasthenia, 90
Adenocarcinoma, embryonal, 159
 gluteal, 195
Adenosine triphosphatase, ATP, 61
Adenosine triphosphate, 62, 101
Adrenal cortical function, 57
Adrenal function tests, 54, 55
Adrenals and fatigue, 107
Age, and bone-fat index, 65
Agenesis, ilium, 195
Albers-Schonberg disease, 21
Albright's syndrome, 145, 146
Alcoholic neuritis, foot, 217
Alpha-aminovaleric acid, 65
Alphatocopherol, 49
American practitioner, 28, 35
Aminopterin in leukemia, 148
Aminopyrine, 58
Amputations, see prostheses
Amputation, after care, 279
 bandaging stump, 277
 brace for strengthening, 276
 Callander type, 271
 center of gravity, 272
 cineplastic, 273, 274
 complications, A-V fistula, 276
 complications, pain, 275
 complications, spondylosis deformans, 272
 deformity of femur, 275
 embolism, 271

Amputation - cont'd

- end bearing stumps, 271
 - forequarter, 272
 - gangrene, 270
 - general consideration, 269
 - hindquarter, 272, 273
 - hip flexion contracture, 279
 - history, 269
 - in Israeli, 279
 - in Malaya, 279
 - Krukenberg, 274
 - Krukenberg-Putti, 274
 - leprosy, 271
 - meningococcus gangrene, 271
 - muscle flaps, 271
 - muscle sense in cineplasty, 274
 - neuromata, 275
 - nursing care, 279
 - partial foot, 271
 - peripheral vascular disease, 270
 - phantom pain, 276
 - postural considerations, 272
 - prostheses, 269-284
 - refrigeration, 270
 - scar revision, 276
 - sensitive scars, 275
 - site, 49
 - stump treatment, 277
 - technique, review, 278
 - thrombo-angitis obliterans, 271
 - ulceration, 275
 - Vanghetti's, 274
- Amyloidosis, 102
- Amyotonia congenita, 89
- Amyotrophic lateral sclerosis, 93, 235
- Anaesthesia, refrigeration, 270
- Anaesthesia complications, brachial block, 247
- Anaesthesiology, 58
- Anatomic variations, toes, 213
- Anatomical aspects of knee, 201
- Anatomical variations of pelvis, 194-195
- Anatomy, cervical vertebrae, 233
 - comparative, elbow, 246
 - hand studies, 259
 - relation, femoral neck to calcaneus, 206
 - skeletal, 64
 - tarsus, 219
- Ankle, 219-222

Ankle, ligament injury, 221
meniscoid lesion, 221
osteochondritis dissecans, 221
rupture tendoAchilles, 219
sprain, 219, 221
strapping, 220
synovitis, 221
tendon rupture, 222
tenosynovitis, 221
tibio-fibular diastasis, 219
x-rays, 220

Ankle and foot, 211-226

Anomalies of carpus, 253

Anterior tibial necrosis, 49

Anterior tibial syndrome, 220

Anthropological studies, hand, 259

Antibodies in milk, 77

Antibodies in poliomyelitis, 73

Anticholinesterase, 61

Antipyretic drugs, 58

Apoplexy, heat, 73

Apparatus, self hoist, 292
splints, 292
for toe flexion, 292

Aran-Duchene disease, 94

Army peripheral nerve register, 98

Arm traction apparatus, 293

Artane in Parkinson's, 97

Arterial constriction, toes, 213

Arteriography, 49

Artero-venous fistula, 49
complication femur stump, 276

Arteriosclerosis, 270

Arthritis, carpometacarpal, 254
cervical, 235
hands, reconstruction, 256-257
hip, 188, 191
inflammatory, hand, 261
knee, 202
shoulder, 231
spine from improper prosthesis, 272
trapezio-metacarpal, 254
trapezio-metacarpal joint, 255
wrist, 253

Arthrodesis, hip, 189, 192
knee, 137, 204
sacro-iliac, 179
shoulder, 98
trapezio-metacarpal joint, 253
tubular saw, 291
vertebra, 291

Arthrography, shoulder, 288
Arthrokatakdysis, 28
Arthro-onychodysplasia, 2
Arthroplasty, elbow, 136
 hip, 46, 136, 189, 193, 194
 knee, 136, 204
 metacarpophalangeal joints, 257
 metatarsophalangeal joints, 257
 tannin in, 65
Arthrosis, lumbar, 179
Artificial limbs, see prostheses
Asbestos splints, 292
Aseptic necrosis, 26, 27
 hip, 188, 189, 190
Aspirin, 58
Ataxia, spinal, nutritional, 102
Athetosis, 87
Athletes foot, 218
Athletic injuries, 167
Atlas of neck conditions, 234
Atrophies, 91-94
Atropine in polio, 78
Aureomycin, 65
 in polio, 78
Autograft, sciatic, 99
Avascular necrosis, 26, 27
Avitaminosis, and foot pain, 216

- B -

Backache, compensation factors, 166
Bacteriology of poliomyelitis, 73
Bamboo staff for deltoid paralysis, 294
Basket splint for congenital hip, 5
Beeswax, 66
Belladonna in Parkinson's, 96
Benadryl in Parkinson's, 96
Biceps cineplasty, 274
Biochemistry, bone, 65
 physiological, 61
Biopsy forceps, 287
Biotin, 65
Bipartite, navicular, 253
Birth trauma, 87
Bis-trimethyl ammonium decane, 63
Bladder, carcinoma of with bone formation, 152
Blastomycosis, hand, 260
Blood flow in toes, 213
Boeck's sarcoid, hand, 260
Bone age, 8

Bone bank, 46, 133, 134, 135
gelatinized bone, 291
Bone changes in paraplegia, 102
Bone cysts, 145, 148
hand, 260
Bone-fat index, 65
Bone formation, 50
Bone graft, 133, 134
gelatinized, 291
Bone growth, 50, 65
Bone holding forceps, 287
Bone mallet, conical, 287
Bone plate, 289
in spine fusion, 136
Bone structure, 50
Botulinum toxin, 59
Bow legs, 202, 215
Bowleg deformity, 132
Brace, buckles, 293
clubfoot, 294
dynamic, triceps, 294
exercise, 295
in cerebral palsy, 89
Brachial block, complications, 247
Brachial neuralgia, 235, 237
Brachial plexus injury, 97 - 99
Breech presentations, 100
Brunhilde polio virus, 73
Buerger's disease, 218
Burns, skeletal suspension, 290
Bursa, suprapatellar, 205
Bursitis, radiohumeral, 246
subacromial, 228
subdeltoid, 228
syphilitic, 17

- C -

C-6, 63
C-10, 63
"Cafe au lait" spots, 149
Caisson disease, hand, 260
hip, 188
Calcaneo-navicular synostosis, 214
Calcific deposits, hand, 252
Calcium, level, estrogen effect, 58
level, in serum, 57
level, in testosterone, effect, 58
metabolism, 50

Callosity formation, 212
Callus inhibited by tannin, 65
Canalography, 172
Capsulectomy, for hip pain, 189
 metacarpophalangeal joints, 257
 metatarsohalangeal joints, 257
Capsulitis, shoulder, 229
Carbon dioxide, bicarbonate buffer, 61
Carcinoid tumors, 151
Carcinoma, with bone involvement, 151
 clavicle, 232
Carotid denervation, 91, 92
Carpal, congenital defect, 3
 ligament syndrome, 247
 lunate excision, 252
Cartilage, grafts, 134
 semilunar, 202-204
Cast spreader, 289
Cauda equina tumor, 178
Cavus feet, 214
Celastic splints, 292
Cellulose, oxidized, 57
Cerebral palsy, see spastics
Cerebral palsy, 86-89
 causes, 87
 classification, 87
 diagnosis, 87
 ski splints for, 292
 treatment, 87, 88
Cervical rib, 237, 238
Cervical vertebrae, anatomy, 233
Charcot knee, 203
Charcot-Marie-Tooth disease, 91
Charcot's arthritis, hand, 261
Chemistry in multiple sclerosis, 95, 96
Chloromycetin, 65
Chlorophyll, 47
Cholinesterase, 61
Chondro-blastoma, benign, 147
Chondro-costal calcification, 161
Chondrodystrophy, foetalis, 17
Chondrogenesis, 65
Chondroitin sulfuric acid, 65
Chondroma, hand, 260
Chondromalacia patella, 205, 206
Chondromatosis, synovial, knee, 203
Chondro-osteoblastoma, 147
Chondro-osteodysplasia, 17
Chondrosarcomatous degeneration, 149

Chordoma, 142, 170
Chordotomy for hip pain, 189
Chronic anterior poliomyelitis, 94
Chronic backache, 166
Chronic nephritis with finger contractures, 261
Cineplasty, 273, 274
Circulation, foetal spine, 57
 toes, 213
Circulatory defects, 87
Clavicle, axial view, 232
 congenital defects, 3
 extirpation, 232
Claw toes, 212
"Clay Shoveller's" fracture, 161
Clinical research, 57
Club foot, 217
 brace, 294
 tendon transplants, 7
 wedged casts, 7
Coccygodynia, 195
Coccyx, dislocation, 195
Codman's tumor, 147
Coefficient, creatin, 61
Coley's toxins, 149, 150
Collagen diseases, 10
Collateral circulation, 49
Compound E, 54
Compressed air drill and bone cysts, 260
Congenital absence of ilium, 195
Congenital anomalies, 87
Congenital bipartite scaphoid, 253, 254
Congenital deformity, etiology, 1
 femur, 274, 275
 head and trunk, 3
 lower extremities, 6
 scope and incidence, 1
 systemic anomalies, 2
 upper extremities, 2
Congenital dislocation, hip, 192
Congenital dysplasia, hip, 188
Congenital luxation, hip, 188
Congenital parietal dysplasia, 179
Congenital pseudarthrosis, 28
Congenital subluxation, talus, 214
Contracture, Dupuytren's, 259 et. seq.
 5th toe, 213
 Volkmann's, 261
Conversion hysteria, 168
Cortisone, 54
 in myasthenia, 90
Coxalgia, 189
Coxarthrosis, 136, 187

Coxa vara, 27, 28
congenital, 3
Coxitis, 28
Coxsachie polio virus, 74
Cranio-cleido-dysostosis, 3
Creatine-creatinine determinations, 61
Crotonoside, 62
Crouzon's sign, 100
Crutch walking, 295
Cryptococcosis, 18
Cultures, embryonic, 64
tissue, 55, 64
Cuneiform dislocations, 218
Curare, 61, 63
in cerebral palsy, 88
in myotonia, 89
in polio, 78
Cushing's disease, 61
Cushing's syndrome, 54
Cycliton, 99
Cytochrome C in amyotrophic lateral sclerosis, 94
Cytochrome oxidase, 62

- D -

Darvisul, 79
Decamethonium iodide, 63
in muscular hypertonus, 93
Decubiti, treatment by skeletal suspension, 290
Deformity, see congenital deformity
Deformity, congenital, 1
cervical spinous processes, 233
femur, 274, 275
foot and ankle, 138
knee, 202
pelvis, 136
scapula, 233
tibial, 137
toes, 213
upper extremity, 135, 136
Degenerative changes in hip, 187
Dehydrogenase, malic, 62
succinic, 62
Delayed suture, 46
Deltoid paralysis bamboo staff, 294
Denervation of hip, 189
DeQuervain's disease, 251
Dermatology, hands and fingernails, 260
Dermoid implantation, hand, 260
Desoxycorti costerone acetate, 61
Development and growth, see growth, see diseases of growing bone
Development and growth, 1
Devices for saw, 287

Diagnostic procedures, 290
Dihydrotachysterol, 19
Diastematomyelia, 4
Dicumarol, 48
Dietary deficiency as cause of congenital deformity, 2
Diparcol in Parkinson's, 96
Diphtheritic paralysis, 101
Disc, diagnosis by EMG, 290
 cervical, 234
 intra-articular, 64
 intra-vertebral, 99
Discoid menisci, 204
Disease of bone, bone destruction, 24
 bone formation, 20
 hereditary, 16
 infections, 17
 metabolic, 18
 Paget's disease, 22
Disease, knee, 202
 Larsen-Johanssen, patella, 206
Dislocation, carpal lunate, 253
 carpal scaphoid, 254
 coccyx, 195
 fibular head, 220
 finger, 256
 head of radius, Monteggia, 245
 hip, 190
 congenital, 192
 traumatic, 188, 189
 metacarpals, 255
 patella, 206
 pelvis, 195
 shoulder, 230-232
 Bankart drill, 288
sterno-clavicular joint, 232
symphysis pubis, 195
talus, 221
tarso-metatarsal joint, 218
thumb metacarpal joint, 254
Disseminated sclerosis, 95
Drilling femoral head, 136
Drugs, antipyretic, 58
 in cerebral palsy, 88
Dupuytren's contracture, 259, et. seq.
Dwarfism, 2, 16, 17
Dwarfs, sketches of, 2
Dyschondroplasia, 2, 16, 17
Dysplasia, hip, congenital, 188
Dystrophy myotonica, 92
 hand, 261
Dystrophy, 91-94
 reflex, post-traumatic, 93

- Echinococcus cyst, 178
 - long bones, 17
 - vertebrae, 18
- Effusion, knee, 202
- Ehlers-Danlos syndrome, 2
- Elbow, ankylosis, 246
 - arthrodysplasia, 2
 - arthroplasty, 136, 246
 - epicondyles, 246
 - gunshot wounds, 246
 - loose bodies, 244
 - Monteggia fracture, 245
 - osteochondromatosis, 245
 - patella cubiti, 247
 - pseudarthrosis, 246
 - tennis, 246
 - transplant of pectoralis major for flexor, 245
- Elbow and forearm, 244-247
- Electrical skin resistance, 75
- Electrolytes, serum, 57
- Electromyography, 79, 106, 290
- Electrophrenic respiration, 80
- Electrophoresis, polio blood, 75
- Embolism and amputation, 271
- Embryology, 58
 - knee, 201, 202, 205
 - sacro-iliac joints, 178
- Embryonic cultures, 64
- Encephalitis, allergic, 73
 - St. Louis, 74
- Enchondral ossification, 65
- Endocrine system, 53-55
- Endometrial tumors of extremities, 148
- Enuresis and retarded bone growth, 10
- Eosinophilic granuloma, 29, 144
- Eosinophils, 57
- Ependymomas, 142
- Epicondyles, comparative anatomy, 246
- Epidemiology of poliomyelitis, 75, 76
- Epidemic, poliomyelitis, 72
 - polio, in Los Angeles, 80
 - polio, in New York City, 75
 - polio, in San Diego, 76
 - polio, in San Francisco, 76
- Epidemic, in England and Wales, 76
 - in Maryland, 81
- Epidermo-phytosis, 218

Epinephrine in myotonia, 89
Epiphyseal, slipping, hip, 188
 stapling, 10
Epiphysitis, juvenile, 161
Equalizing leg length, 80
ERB-Goldfam myasthenia, 90, 109
Estrogen, 55
 effect on calcium, 58
Ether, 58
Ethylene diamine tetra-acetic acid, 57
Eulissin, 63
Ewing's sarcoma, 149, 150
Excision, clavicle, 232
Excision, total, sterno-mastoid, 236
Exercise apparatus, 295
Extracts, tissue, 55

-F-

Facioscapulohumeral dystrophy, 17
Fanconi syndrome, 19, 20, 25
Fascia lata for tendon repair, 291
Fat-bone index, 65
Feet, congenital defects, 3
 club, 7
 metatarsal hypertrophy, 6
 metatarsus varus, 6
Femoral-calcaneal angle, 207
Femur, fracture after irradiation, 151
 fracture of neck, 188
 metastasis, 151, 152
Fever therapy in polio, 78
Fibrin foam, 57
Fibrodystrophy, muscular, 92
Fibrosarcoma, 149, 150
 humerus, 272
Fibrosis, periarticular, 56
Fibrositis, 167, 168
Fibrous dysplasia, 28, 144, et. seq.
Fibula, dislocation, 220
 high head, 204
Finger, see hand
Finger, anatomical studies, 259
 exercises, 256
 flexion contractures with nephritis, 261
 fractures, 256
 infections, 255
 metacarpophalangeal joints, 257
 metatarsophalangeal joints, 257
 pulp space infections, 255

Finger - cont'd

- reconstruction, 258
- reconstruction of arthritic, 257
- splints, 256
- Thiermann's disease, 261
- thumb reconstruction, 258
- transplant to thumb, 258
- transplant from toes, 258
- trigger, from collateral ligament, 262

Fingers and hand, 255-262

Fingernail, dermatology treatise, 262

- dysplasia, 2

Flail foot, 217

Flat foot, 213

Flavone, 62

Flaxedil, 63

Fluoroscope in shoe stores, 213

Folic acid, 54, 63

Foot, Buerger's disease, 219

- dislocations, 218
- infection, 218
- ingrowing toenail, 218
- leprosy, 221
- madura, 219
- partial amputation, 271
- plantar warts, 218
- pseudarthrosis, 218
- stabilization, 217
- trench foot, 219

Foot and ankle, 211-226

Forceps, biopsy, 287

- bone holding, 287

Forearm, acroparesthesia, 245

- Monteggia fracture, 245

Forearm and hand, 244-268

Forequarter amputation in 1808, 272

Formol toxoid, 101

Fracture, acetabulum, 190

- Bennett's, 254

- callus, 65

- carpal navicular, 253

- carpal scaphoid with arthritis, 253

- "Clay Shoveller's", 161

- compound, osteosynthesis, 119

- defects, 132-138

- elbow, 121

- embolism in, 119

- emergency treatment, 117

- experimental, of ankle, 127

Fracture - cont'd

- femur, in children, 124
- finger, 256
- foot, 127, 128
- foot and ankle, 138
- forearm, 121
- general, 117-120
- grafting, 134, 135
- hand, 122
- head and trunk, 120
- healing research, 119, 120
- hip, 122, 123, 124, 190
- hip nailing devices, 286, 287
- hip nailing, guide wires, 289
- history of, 118
- intramedullary fixation, 125, 133
- lower extremity, 122
- Monteggia, 245
- neck of femur, 188
- nerve involvement, 135
- non-union, 138
- non-union of, carpal scaphoid, 253
- os calcis, 128
- patella, 6, 126, 127, 205
- pelvis, 120
- radial styloid, 253
- tibia, 126
- tibial defects, 137
- treatment, arm traction, 293
 - Blade plates, 121
 - dual slotted plates, 125
 - external fixation, 119, 122
 - new pin and stirrup, 288
 - threaded wires, 121
 - upper extremity, 120-122
 - vertebrae, 120
- Fracture-dislocation, hip, 123, 124
 - shoulder, 231, 232
- Franceschetti syndrome, 3
- Frejka pillow splint, 5
- Frozen bone, 133
- Fungus infection, foot, 218
 - vertebrae, 18
- Funnel chest, 136
 - etiology, 3
 - in military personnel, 4
 - surgical treatment, 4
- Furmethide in polio, 78
- Fusion, knee, 137

Gangrene, 49, 270
 sciatic paralysis, 99
Gaucher's disease, 29, 148
Gelatin sponge, 57
Gelatinized bone, 291
Gelfoam, 57
General paresis, 93
Genu recurvatum, role of rickets, 6
Genu valgum, role of rickets, 6
Genu varum, role of rickets, 6
Giant cell granuloma, knee, 203
Giant cell tumor, 143, 145, 147, 149
Glomerular filtration, 61
Glomus tumor, 260
Glycogen body, 58, 59
Gonorrhea and knee, 202
Gout, hand, 260, 261
 knee, 202
Graft, nerve, 99
Growth, anthropological aspects, 8
 development, 1
 dietary requirements, 9
 diseases of growing bone, 16
 experimental work, 8
 normal, 7
 rates, 55
 restriction of bone growth, 9
 tendon, 56
 tissue, 55-57
Grynfelt's triangle hernia, 179
Guillain-Barre syndrome, 97
Gunshot wounds, 138

Hallux rigidus, 212
Hallux valgus, 211
Hallux varus, 212
Hamartoma, hand, 260
Hammer toes, 212
Hand, see fingers
Hand, arthrodesis, trapezio-metacarpal joint, 255
 Bennett's fracture, 254
 blastomycosis, 260
 bone cysts, 260
 brachial block complications, 247

Hand - cont'd

broadening of thumbs, 248
caisson disease, 260
calcific deposits, 252
carpal metacarpal arthritis, 254
compressed air drill disease, 260
congenital deformities, 3
DeQuervain's disease, 251
dislocation, metacarpals, 254
dominance, 8
Dupuytren's contracture, 259, et. seq.
dystrophia myotonica, 261
excision trapezium, 255
flexion contractures, 248
gout, 261
hamartoma of palm, 260
hydatid disease, 260
infections, 255
inflammatory rheumatism, 261
lipomata, 261
metacarpophalangeal joints, 257
metatarsophalangeal joints, 257
muscles, anomalous innervation, 248
neuropathy, median, 247
opponens pollicis paralysis, 249
osteomyelitis, 261
overshoe buckles for brace cuff, 293
pleonosteosis, 248
Raynaud's disease, 247
reconstruction of arthritic, 257
 palmar post, 291
sclerodactylta, 247
skin plastic procedure, 257
splints, 256, 293
stenosing tenosynovitis, 251
surgery, 244, 249
 general, 256
 retractor, 288
surgical repair, thumb metacarpal joint, 254
tendon grafts, 249, et. seq.
tendon repair, 249
tenosynovitis, suppurative, 255
thumb reconstruction, 258
thumb web repair, 259
trapezio metacarpal arthritis, 254
trigger finger, 251
Volkmann's contracture, 261
yaws, 260

Hand and fingers, 255-262
Hand and forearm, 244-268
Hand and nails, dermatology treatise, 262
Hand-Schuller-Christian's disease, 29, 144, 145
Hand and wrist, 247-255
Hardy-Wolff-Goodell, test, 58
Head, congenital defect, 3
Headache, post traumatic, 235
Heat, radiant, test, 58
Hemangioendotheliomas, 142
Hemipelvectomy, 272, 273
Hemiplegia after tonsillectomy, 103
Hemostatic agents, 57
Heredity in muscular dystrophy, 91
Hernia, lumbar, 179
Herniated disc, extra lumbar, 160
 results of treatment, 177
Herniation, lumbar fat, 170
Hexamethonium bromide, 63
Hindquarter, amputations, 272, 273
Hip, abductor paralysis, 80
 anteversion, congenital, 5
 arthritis, 188, 191
 arthrodesis, 189, 192
 arthroplasty, 136, 189, 193, 194
 aseptic necrosis, 188
 calcifying lesion, 230
 capsulectomy for pain, 189
 congenital dislocation, 5, 192
 in Manitoba Indians, 5
 non-surgical treatment, 6
 surgical treatment, 5
 congenital dysplasia, 188
 basis for other entities, 5
 early diagnosis, 5
 congenital luxation, 188, 189
 denervation, 189
 dislocations, 190
 flexion contracture, amputation for, 279
 fractures, 190
 Gibson posterior approach, 189, 291
 injection of lactic acid for pain, 191
 joint and pelvis, 187-200
 joint disease, 136, 137
 myositis ossificans, 190
 nailing devices, 286, 287
 osteochondritis dissecans, 188
 osteochondromatosis, 188
 pain, 187-189
 prosthesis for, 189

Hip - cont'd
reconstruction surgery, 190-194
shelf operation, 189
splint for rotation, 294
Tavernier's operation, 193
trauma, 190
tuberculosis, 189
Histiocytic granuloma, 144
Histiocytoma, 147
History of poliomyelitis, 72, 73
Hodgkin's disease, 144, 147
Horner's syndrome as complication of brachial block, 247
Huffert's disease, 30
Humerus, epicondyles, 246
Hunter's dwarfs, 2, 11
Hyaline cartilage, 65
Hyaluronidase, 54, 65
Hydatid disease, hand, 260
Hydrarthrosis, knee, 202
Hyperparathyroidism, 28
 acromioclavicular changes, 232
 hand, 260
Hyperplasia of bone, 144
Hypertensive vascular disease, 247
Hypocalcuria, 25
Hypoxia, 87

- I -

Iliac horns, 2
Iliac spurs, 2
Immunology in poliomyelitis, 73
Index, creatine, 61
 fat-bone, 65
Indications for amputation, 269
Infantile cortical hyperostoses, 18, 21
Infantile paralysis, see poliomyelitis
Infection, amputation, 270
 fingers and hand, 255
 knee, 202
 pulp space, 254
 spine, 178
Injection, lactic acid for hip pain, 191
Injuries of foot, 216
Instrument, Bankart drill, 288
 biopsy forceps, 287
 bone holding forceps, 287
 goniometer, 288
 mallet, 287
 retractor, hand surgery, 288
 saw attachment, 287
 self retaining retractor, 288
 skin grafting, 288
 universal stapler, 288

Insulin in muscular dystrophy, 92
Internal derangement, knee, 203
Interscapulothoracic amputation, 272
Intertrochanteric osteotomy, 190
Intervertebral disc, 160, 169, 170, 171
 Intocostrin, 88
 for phantom limb, 276
Intradural granuloma, 145
Intramedullary lipoma, spinal cord, 145
Intramedullary nail, 46
Intrapelvic protrusion, 28
Iontophoresis for bursitis, 229
Irradiation necrosis, 27
Ischemic necrosis, 26, 27
Ischemic pain, 79
Isoguanosine, 62
Israeli, amputations and prosthesis in, 279

- J -

Joint mice, 203
 elbow, 244
Joint movement, 64
Joint, sternoclavicular, 232

- K -

Kahler's disease, 30
Kienboeck's disease, 252, 253
Knee, arthritis, 202
 arthrodesis, 204
 arthroplasty, 136, 204
 closed reduction, loose bodies, 207
 contracture in cerebral palsy, 88
 deformities, 202
 disalignment, 6
 discoid menisci, 204
 effusion, 202
 embryology, 205
 flail, 203, 207
 fusion, 137
 gout, 202
 infection, 202
 joint, 201-210
 anatomical aspects, 201
 ligaments, 205
 menisci, 201-205
 patella, 205-206
 quadriceps, 206
 synovial membrane, 205
 loose body, 203
 reconstruction surgery, 204
 rupture of quadriceps, 206
 tumors, 203

Knock knee, 202, 215
Kronecker slide, 61
Krukenberg amputation, 274

- L -

Lactic acid injection for hip pain, 191
Lambrinudi operation, 99
Laminae, zonal, 63
Laminectomy, 99
 tables, 293
Lansing polio virus, 74
Leg, gravitational ulcer, 222
Leg length, 137
Legg Perthes disease, 26, 188
Lengthening, leg, 80
 operation, 137
Leprosy, foot, 271
 talus, 221
Letterer-Siwe's disease, 29, 144
Leukemia, acute, 148
Ligament, collateral, metacarpophalangeal joints, 257
 collateral, metatarsophalangeal joints, 257
 collateral, metacarpophalangeal causing trigger finger, 262
 coraco-acromial, 229
 foot, 219
Limb fitting, see prosthesis
Lipid granulomatosis, 144
Lipoid types tumor, 144
Lipoma, palm, 261
 sacral region, 170
Lobectomy for metastasis, 150
Loose body, elbow, 244
 knee, 203
Low back, 165-186
 anatomical studies, 165, 166
Low back pain, 195
 treatment, 167
Lumbar, arthrosis, 179
 fat herniation, 170
 hernia, 179
 spine, degenerative lesions, 166, 167
 venous plexus, 166
Lumbosacral, articulations, 166
 fusion, 133, 136
 malformations, 178
Lunate, carpal, 253
Luxation, hip, congenital, 188
Lymphogranuloma inguinale and knee, 202

- Manipulation, neck, 233
- Madura foot, 219
- Magnesium, effect on serum calcium, 57
- Malaya, amputations and prostheses, 279
- Malformations, lumbosacral, 178
- Malic dehydrogenase, 62
- Malignant degeneration, 149
- Mandible, malignant, tumors of, 149
- Manipulative therapy, 167, 176
 - foot, 213
- Marble bones, 21
- Marie-Strumpell spondylitis, 178
- Matrix, of bone, 64
- Measurement of pain, 58
- Medial malleolus pseudarthrosis, 218
- Median nerve neuropathy, 247
- Melanoma, 151, 159
- Meningeal hemangioma, 29
- Meninges, tumors, 142
- Meningitis, 87
 - influenzae, 101
- Meningocele, treatment, 4
- Meningococcaemia and gangrene foot, 271
- Meningo-encephalitis, 18
- Menisci, 64
- Meniscoid lesion, ankle, 221
- Metabolic biochemistry, 61
- Metabolism, calcium, 50, 55
 - phosphorus, 50, 55
 - studies, 54
- Metacarpal, congenital deformity, 3
 - dislocation, 255
- Metastases, hand, 260
- Metatarsal, hypertrophy, 6
- Metatarsalgia, 213
- Metatarsus varus, 6
- Methyl testosterone, 61
- Micromelia, 17
- Microradiography, 285
- Mongoloids, x-ray studies, 4
- Monteggia fracture, 245
- Morquio's disease, 17
- Mortality in polio, 79
- Morton's toes, 248
- Movements, joints, 64
- Multiple myeloma, 150, 151
 - in Paget's disease, 22, 30
- Multiple neurofibromatosis, 149
- Multiple sclerosis, 94

Muscle, anterior tibial syndrome, 220
dystrophy, 62
external oblique, 80
necrosis, 49
nerve preparations, 58-63
physiology, 60
relaxants, 63
rupture pectoralis major, 233
scalenus anticus syndrome, 236
spasm, 59
sterno-mastoid, excision, 236
strength, 59
striated, 63
transplants in club foot, 7
transplant of pectoralis major, 245
transplant, shoulder, 98
Muscular dystrophy, 61
classification, 91
Muscular fibrodystrophy, 92
Muscular hypertonus, 93
Muscular system, 59-63
Musculus extensor hallucis brevis weakness in 14 discs, 175
Myalgia, acroparesthesia, 245
Myasthenia, congenital, 89
 gravis, 89, 90
 neonatorum, 89
Myco-butyricin, 73
Myelograms and peridurograms, 171, et seq
Myeloma, multiple, 150
 solitary, 151
Myopathy, 100
Myobilin in muscular dystrophy, 91
Myography, 60
Myopathies, 89-94
Myosin, 61
Myositis ossificans, blocking hips, 24
 hip, 190
 malignant degeneration, 149
 progressive, 24
Myotonia congenita, 89

- N -

Nail, intramedullary, 133
 primary carcinoma of, 152
Navicular fracture, 253
Neck, 233-238
 anatomy, 233
 arthritis, 235
 cervical rib, 237, 238

Neck - cont'd
 clinical atlas, 234
 herniated nucleus pulposus, 234
 scalenus syndrome, 236
 spasmodic torticollis, 236
 stuck joint syndrome, 236
 x-ray, 233

Neck and shoulder, 227-243

Necrosis of muscle, 49

Neoplastic bone diseases, 29

Neostigmine, 58
 in cerebral palsy, 88
 in myasthenia, 89, 91

Nephritis, chronic, with finger contractures, 261

Nerve, anomalous, hand, 248
 Army peripheral register, 98
 graft, 99
 pathway of polio virus, 74
 peripheral, injury to, 98

Nerve root, compression syndrome, 290
 encroachment, 171
 pain, 99

Nervous system, trauma to, 97
 diseases, varied, 94-97

Neural arch, ossification of, 195

Neuralgia, cervicobrachial, 234, 237

Neurectomy, hip, 189

Neuritis, alcoholic, foot, 217

Neurofibroma, 142, 146

Neurofibromatosis, 28, 149
 hand, 260

Neuromata in stumps, 275

Neuromuscular disorders, 86-116

Neuropathy, median, 247
 multiple, 103

Neurosurgery for pain, 104

Neurovascular conditions, hand, 247

New apparatus, devices, procedures, 285-299

Newborn, polio in, 75

New devices, procedures, apparatus, 285-299

New procedures, devices, apparatus, 285-299

Nicotine, 61

Nicotinic acid, 101

Nitrogen, total, 64

Non-union, hip fracture, 190
 tibia, 138

Normal growth, 7

Norvalin, 65

Nursing care, amputees, 279

Nursing, self hoist, 292

Nylon arthroplasty, knee, 204

Obturator neurectomy, 189
Occupational therapy, 50
Ollier's disease, 16, 17
Operating tables, prone, 293
Orthopedic treatment, cerebral palsy, 88, 89
Orthoroentgenography, 290
Os calcis, fracture, 138
Os purum, grafts in congenital hips, 6
Ossein, 65
Ossification, enchondral, 65
 neural arch, 195
Osteitis condensans ilii, 20
Osteitis deformans, 22
Osteitis fibrosa cystica, hand, 260
Osteochondritis dissecans, elbow, 245
 hip, 188
 shoulder, 232
 talus, 221
 patella, 206
 sacro-iliac, 178
 vertebral, 29
Osteochondromatosis, elbow, 245
 hip, 188
Osteoclasia, 132
Osteoclastoma, 147
Osteoclasts, 64
Osteodystrophia fibrosa cystica, 28
Osteogenesis, 63, 64, 65
 imperfecta, 2
Osteogenic sarcoma, 143, 149
 complication of Paget's, 22
Osteoid-osteoma, 146
Osteolysis, carpal scaphoid, 254
Osteoma, 146
Osteomalacia, 24, 25, 26
Osteomyelitis, 138
 hand, 261
 hindquarter amputation, 272
Osteopathic treatment, neck pain, 233
Osteopetrosis, 20, 21
Osteopoikilosis, 26
Osteoporosis, 23, 24, 25, 26
Osteosclerosis, 21
Osteosynthesis, see arthrodesis
 internal fixation
 fracture treatment
Osteosynthesis, 133

Osteotomy, femoral, 137
 intertrochanteric, 191
knees, 207
Marziani's dentate, 132
spine, 160
Otto pelvis, 188
Overlapping fifth toe, 213

- P -

P-31, 64
Paget's disease, 22, 23, 147
 with mental changes, 104
Pain, 104-107
 after amputation, 275
 ischemic, 79
 low back, 195
 measurement, 58
 phantom, 276
 polio, 79
 rectal, 195
 relief, 290
Pantothenic acid, 65
Paralysis, agitans, 96
 irreversible, 59
 median nerve, 247, 248
 peripheral nerve, 97, 98, 99
Paraplegia, 145, 178
 bone changes in, 102
Parasitic infections, 161
Parasthesia, acro, 245
Patella, 205-226
 absence of, 2
 cubiti, 247
 dislocations, 206
 fractures, 205
 Larsen, Johanssen disease, 206
 rudimentary, 2
Patellectomy, 205, 206
Pathology in poliomyelitis, 75
Peanut oil, 66
Pelvis, anatomy of, 194
 deformity, 136
 secondary sex differences, 195
Pelvis and hip joint, 187-200
Penicillin, 66
 in polio, 78
Percussion treatment, neuromata, 275

Periodic paralysis, 92
Peripheral vascular conditions, 48-50, 269, 270
Peritendinitis, ankle, 221
 shoulder, 229, 230
Perthes-Jungling disease, 29
Perthes disease, 188
Pethoesthor, 37
Petit's triangle hernia, 179
Phantom limb, 106
 pain, 276
Phenacetin, 58
Phenosulfasole, 79
Phenothiazine in Parkinsons, 96
Phlebothrombosis, 49
Phosphorus, excretion, 61
 metabolism, 50
 radioactive, 64
 and carcinogenetic effect, 143
Physical therapy, 80, 81
Physiological biochemistry, 61
Physiology, of muscle, 60
 in poliomyelitis, 75
Physostigmine, 61
Pigeon toe, 6
Pituitary insufficiency, 101
Planigraphy and differentiation techniques, 285, 286
Plantar warts, 218
Plastic splints, 292
Plastic surgery, hand, 257
Pleonosteosis, 248
Pneumothorax, brachial block, 247
Poliomyelitis, see infantile paralysis
Poliomyelitis, 72-85
 chronic anterior, 94
 hip splint, 294
 overshoe buckles for braces, 293
 vasospasm in, 97
Polyethylene splints, 292
Polyostotic fibrous dysplasia, 28, 260
Polysyndactylism, 212
Popliteal wound, 99
Position, effect of, on muscle strength, 59, 60
Posterior exposure, hip, 189
Posture, in amputees, 272
 in coccygodynia, 195
Potassium, serum level, 57, 93
Potassium serum, in polio, 75
Precipitations, zonal, 63
Prefrontal leukectomy, 115
Pregnancy in multiple sclerosis, 95

- Pre-sacral neurectomy for hip pain, 189
Preservation of bone, 133-135
Preventive measures, foot, 216
Priscoline, 79
 in polio, 78
Procaine for pain, 290
Prognosis in polio, 81
Progressive muscular atrophy, 91
Pronated feet, 213, 214
Prostheses, see amputations
Prostheses, attachment for short stumps, 294
 bent knee, 278
 complications, spondylosis deformans, 272
 disadvantages of physiological knee, 278
 fitting, 277
 general, 278
 friction in, reducing, 278
 hip, 189
 in Israeli, 279
 in Malaya, 279
 material, plastogen, 278
 pasteboard, 277
 peg leg, 278
 replacement, shoulder, 232
 slip socket, 277
 suction socket, 278
 uniaxial knee, 278
 walking school, 278
Prostheses and amputations, 269-284
Prostigmine, 58, 63
 effect of on eye, 91
 in myotonia, 89
Protein metabolism in growth studies, 7
Pseudarthrosis, 126, 133
 elbow, 246
 foot and shoulder, 218
 hip, 190
Pseudocystic disease, 144
Pseudomonas aeruginosa pyoarthritis of knee, 203
Psoas abscess, 178
Psychiatric therapy, in cerebral palsy, 88
 for phantom limb, 276
Psychological test in multiple sclerosis, 95
Psychosomatic back pain, 168
Psychosomatic disorders, musculoskeletal system, 106
Pubis, congenital defects, 3
Puerperal creatinuria, 61
Pulmonary osteoarthropathy, 24
Putti-Krukenberg amputation, 274
Pyelosil, arthrograms, 228
Pyridoxine in polio, 78

Quadriceps, 206
 rupture, 206
Quadriplegics, triceps brace, 294
Queckenstedt test, 102
Quinidine in myasthenia, 91
Quinine in myotonia, 89

Radial nerve involvement, 135
Radial nerve paralysis, 98
Radiant heat test, 58
Radiation, 48
Radiation therapy, Sudeck's, 105, 106
Radiculitis and EMG, 290
Radioactive drugs in relation to malignancy, 143
Radioactive phosphorus, 64
Radiography, see X-ray
Radiography, myelogram and peridurogram, 172, 173
Radiotherapy in Parkinson's, 96
Radius, congenital defects, 3
 hereditary subluxation of head, 2
Raynaud's disease, hand, 247
Recklinghausen's disease, 28
Reconstruction, fingers, 258
 hip, 190-194
 surgery, knee, 204
Rectal pain, 195
Reflex dystrophy, 93
Reflexes, deep, leg, 166
Refrigeration, anaesthesia, 270
Rehabilitation, amputee, 279
 amputees in Israeli, 279
Renal dysplasia with multiple deformities, 2
Repair, first carpometacarpal joint, 254
Research, 53-71
 clinical, 57
 in poliomyelitis, 73-75
Respiration in polio, 80
Respirator, electrophrenic, 80
Reticulo-endothelial types of tumor, 144
Reticuloendothelioma, 91, 109
Reticuloendothelioses, 29
Reticulo-sarcoma, malignant, 147
RH factor, 87
Rheumatic fever and knee, 202
Rheumatoid arthritis, 54
 shoulder, 231
Rhizotomy, 79
Ribs, ossification of, 24

Rickets, 19, 20
 renal, with genu valgum, 6
Ringworm, foot, 218
Rocker foot, 214
Roentgenology, see x-ray
Root involvement, 99
Rotator cuff lesions, 228, 232
Rubella as cause of congenital malformations, 2
Rupture, anterior tibial tendon, 222
 disc, neck, 234
 pectoralis major, 233
 tendoachilles, 219
 tendon quadriceps, 206
 wrist flexors, 252

- S -

Sacro-iliac arthritis, 178
 embryology, 178
 joint, osteitis condensans ilii, 20
Sacrolisthesis, 170
Sarcomas, 142, 143, 144
Saw, new table attachment, 287
Scaphoid, fracture, 253
 pseudarthrosis, 218
Scapula, fixation, 79
 snapping, 232
Scapulo-humeral dystrophy, 17
Scapulo-humeral myopathy, 94
Scar, amputation stumps, 276
 contraction, hands, 257
Scheuermann's disease, 161
Sciatic pain, 166-177
Sciatic paralysis, 99
Sclerodactylia, 247
Scleroderma, 28, 29
Sclerotome distribution, 235
Scoliosis, 158, 159, 160
 classification, 159
 olisthetic, 160
 radiation, 159, 160
 rotation in, 158
 treatment, 159
Scurvy, 56
Selye's theory, 55
Serology in poliomyelitis, 75
Serum, calcium, 57
 electrolytes, 57
 electrophoresis, in polio, 75
 potassium, 57
Sesamoid, 64
 patella cubiti, 247
Sewage, polio virus in, 74
Sex hormones, 54

Shelf operation, 189
Shoes, fitting of, 217
Shoulder, anterior approach, 227
 arthrodesis, 79
 arthrography, 228
 bursitis, 228
 congenital subluxation, 3
 dislocation, 230-232
 Bankart drill, 288
fracture-dislocation, 231
frozen, 228
girdle, amputation, 272
 injury, 233
osteochondritis, 232
pain, 228
paralytic, 79, 98
periarthritis, 230
prosthetic replacement, 232
rheumatoid arthritis, 231
spica frame, 293
transacromial exposure, 227
x-ray views, 228
Shoulder-arm pain, 233
Shoulder and neck, 227-243
Silk sutures, 256
Skeletal suspension for decubiti, 290
Skeletal system, 63-65
Skin, electrical resistance, 75
 grafting device, 288
 grafts, 47
 hand, 257
Skis for spastics, 292
Skull, disarticulated, 64
Slipped epiphysis, hip, 188
 upper femoral, 27
Slipping rib syndrome, 161
Snapping, finger, 262
 scapula, 232
Spasm, muscle, 59
Spastic, aid to walking, 294
 contracture, calf muscles, 127
 flat foot, 213
 ski splints for, 292
Spastic paralysis, see cerebral palsy
Spastic paralysis, 87
 overshoe buckles for braces, 293
Speech difficulty and handedness, 8
Spina bifida, 166
 occulta with other defects, 4

Spinal, ataxia, nutritional, 102
cord, 100
 tumors, 102
epidural space abscesses, 177
fluid studies, 100
fusion, 99, 133, 136, 168, 169, 170, 176, 177
 tables, 293
Spine, foetal circulation, 57
infections, 178
Splint, Allen-Mason modification, 256
 celastic, 292
congenital hip, Frejka, 5
 basket, 5
Denis-Browne, clubfoot, 6
hand, 293
 hip rotation, 294
knuckle-bender, 256
polyethylene and asbestos, 292
radial, 98
substitute, bamboo staff for deltoid palsy, 294
Spondylarthritis, 166
Spondylitis, ankylosing, 160
 cervical, 235
 tubercular, 178
Spondylolisthesis, 166, 169, 170, 195
Spondylosis deformans and improper prosthesis, 272
Stabilization, foot, 217
Stapling, epiphyses, 10, 46
Steel sutures, 256, 289
Stenosing tenosynovitis, hand, 251
Sternoclavicular luxation, 232
Steroids, 54
Stiff neck, 236
Stilbesterol, 55
St. Louis, encephalitis, 74
Stoffel procedure, 127
Stoffel-Silverskjold operation, 103, 104
Stools, polio virus in, 74
Striae, in lumbar arthrosis, 179
Striped muscle, 63
Stuck joint syndrome, 236
Sturge-Weber syndrome, 29, 93
Subluxation, congenital talus, 215
Substance, osteogenetic, 64
Succinic dehydrogenase, 62
Sudeck's syndrome, x-ray treatment, 105, 106
Supra-patellar bursa, 205
Surgery, in progressive muscular atrophy, 91
 in polio, 79

Surgical approach to hip, Gibson, 189
Surgical table, 293
Surgical technique, wires, 289
Suture, material, 256
 wire, 289
Sympathetic surgery for phantom limb, 276
Sympathectomy, 104, 105
Symphysis, horizontal, 195
Syncurine, 63
Syndactylism, multiple, 212
Syndrome, anterior tibial, 220
 carpal ligament, 247
 scalenus anticus, 236
 stuck joint, 236
 supra-clavicular angle, 237
Synostosis, calcaneo-navicular, 214
Synovectomy, hip pain, 189
 knee, 205
Synovial membrane, permeability, 54
Synovitis, ankle, 221
Syphilis, 17
 general paresis, 93
 knee, 202
Syringomyelia, 101
 and knee, 202

- T -

Talipes calcaneovalgus, 217
Talo-calcaneal bridge, 214
Talus, dislocation, 221
 osteochondritis dissecans, 221
 vertical, 215
Tannin, in arthroplasty, 65
Tantalum mesh, 48
Tarso-epiphyseal aclasis, 215
Tarso-metatarsal dislocations, 218
Temperature, regulation, 58
Tendinitis, Achilles, 216
 biceps, 228
 supraspinatus, 228
Tendon, Achilles, rupture, 219
 grafts, hand, 249 et seq
 growth, 56
 inflammatory lesions, 221
 injury, ankle, 221
 repair, hand, 249
 with fascia lata, 291

Tendon - cont'd

- rupture, anterior tibial, 222
 - quadriceps, 206
 - supraspinatus, 228
 - wrist flexors, 252
- transplants in clubfoot, 7

Teneleryl, 62

Tennis elbow, 246

Tenosynovitis, acute, suppurative, 255

- ankle, 221
- stenosing, hand, 251

Test, Hardy-Wolff, 58

- radiant heat, 58

Testicular, carcinoma with bone metastasis, 152

Testosterone, 62

- effect on calcium, 58
- methyl, 61

Tetany, 57

Tetraethyl, ammonium chloride for phantom pain, 276

- ammonium treatment, 230
- pyrophosphate, 61

Thiamine HCl in polio, 78

Thiermann's disease, fingers, 261

Thiopentyne, 99

Thoracic discs, 160

Thorax, congenital defects, 3

Thorax and dorsal spine, 158-164

Thorium, 37

Thorn's test, 54, 55

Thrombectomy, 49

Thromboangitis obliterans, 219, 271

Thrombophlebitis, 49

Thumb reconstruction, 258

Thymectomy, 90

Thymoma, 91

Thymus in myasthenia, 90

Thyroid, 61

- cancer, 151

Tibia, deformity, 137

- non-union, 138

- rotation, 6

Tissue, banks, 133, 134

- cultures, 55, 64

- extracts, 55

- growth, 55-57

Tocopherol in amyotrophic lateral sclerosis, 94

Toe, 211
flexion for walking, 292
joints in gout, 202
Morton's, 248
pigeon, 6
transplant to hand, 258
Toenail, ingrowing, 218
Tolserol in cerebral palsy, 88
Tonsillectomy and polio, 76
Topectomy, 113
in Parkinson's, 96
Torticollis, 236
ocularis, 237
spasmodic, 106, 236
Torulosis, 18
Total nitrogen, 64
Toxin, botulinum, 59
Transsection of cord, 100
Transillumination of finger tips, 256
Transplant, external oblique, 80
pectoralis major, 245
of tendons in club foot, 7
Trapezium, excision, 255
Trauma, hip, 190
and poliomyelitis, 77
Traumatic neurosis, 168
Treatment of poliomyelitis, 78
Trench foot, 213, 219
Triceps brace, 294
Trigger finger, 251
new concept, 262
Trunk, congenital defect, 3
Tuberculosis, 40
age and race, 38
allergy and immunity, 37, 38
cephalalgia, 38
elbow, 41
general considerations, 37
hand, 260
hip, 39, 41, 189
knee, 3, 39, 202
laboratory findings, 38
meningitis, 37, 39
neo-antergan, 40
neomycin, 40
pancreatic extract, 40
paraminosalicylic acid, 40
phenergan, 40
promizole, 40
regional considerations, 38
shoulder, 41
spine, 38, 39
sternum, 38
streptomycin in, 39, 43
streptomycin, resistance to, 40

Tuberculosis - cont'd

surgery, 41
tenosynovitis, 39
therapy, 37-41
thorotrust, 37, 40
vertebra, 178

Tubocurarin, 63

Tumor, 87, 142-152
cord, 170
Ewing's, femur, 272
fibrosarcoma, humerus, 272
hand, 260
intraspinal, 142
knee, 203
malignant melanoma, 273
neurofibrosarcoma, thigh, 272
pelvis, 195
spinal cord, 102
transplantable, 143

- U -

Ulcer, leg, gravitational, 222

Ulna, Monteggia fracture, 245
Ultrasonic therapy, arthroses, 106
Ultrasound, 234
Upper extremity deformity, 135
Uricase, 62

- V -

Vanghetti's amputation, 274
Varicose ulcer, 222
Varicose veins, 48
Vascular studies, toes, 213
Vascular system, 57, 58
Venous plexus, lumbar, 166
Venous stasis, 48
Venous thrombosis, 49
Vertebra, arthrodesis, 291
 cervical, anatomy, 233
 congenital deformity, 3, 4
 Ewing's tumor, 150
 parasitic infection, 161
 plana, 29
Vertebral, infections, 178
 neural arch, 166
 osteotomy, 160
Vertical talus, 214-215

Virus, Brunhilde, 73
Coxsackie, 74
infections, 87
Lansing, 74
mouse, polio, 78
polio, in sewage, 74
 spread in nerve, 74
 survival, 74
tests in poliomyelitis, 73
Vitallium, cup, 136
 lunate, 253
 plate in osteotomy, hip, 137
Vitamin, 8, 9, 18, 19
 Vitamin A, 55
 Vitamin B₁, 101
 Vitamin E, 61
 in amyotrophic lateral sclerosis, 94
 in Dupuytren's contracture, 259
 deficiency, 56
Vocational guidance for amputee, 279
Volkmann's contracture, 62
 hand, 261
Von Recklinghausen's disease, 149

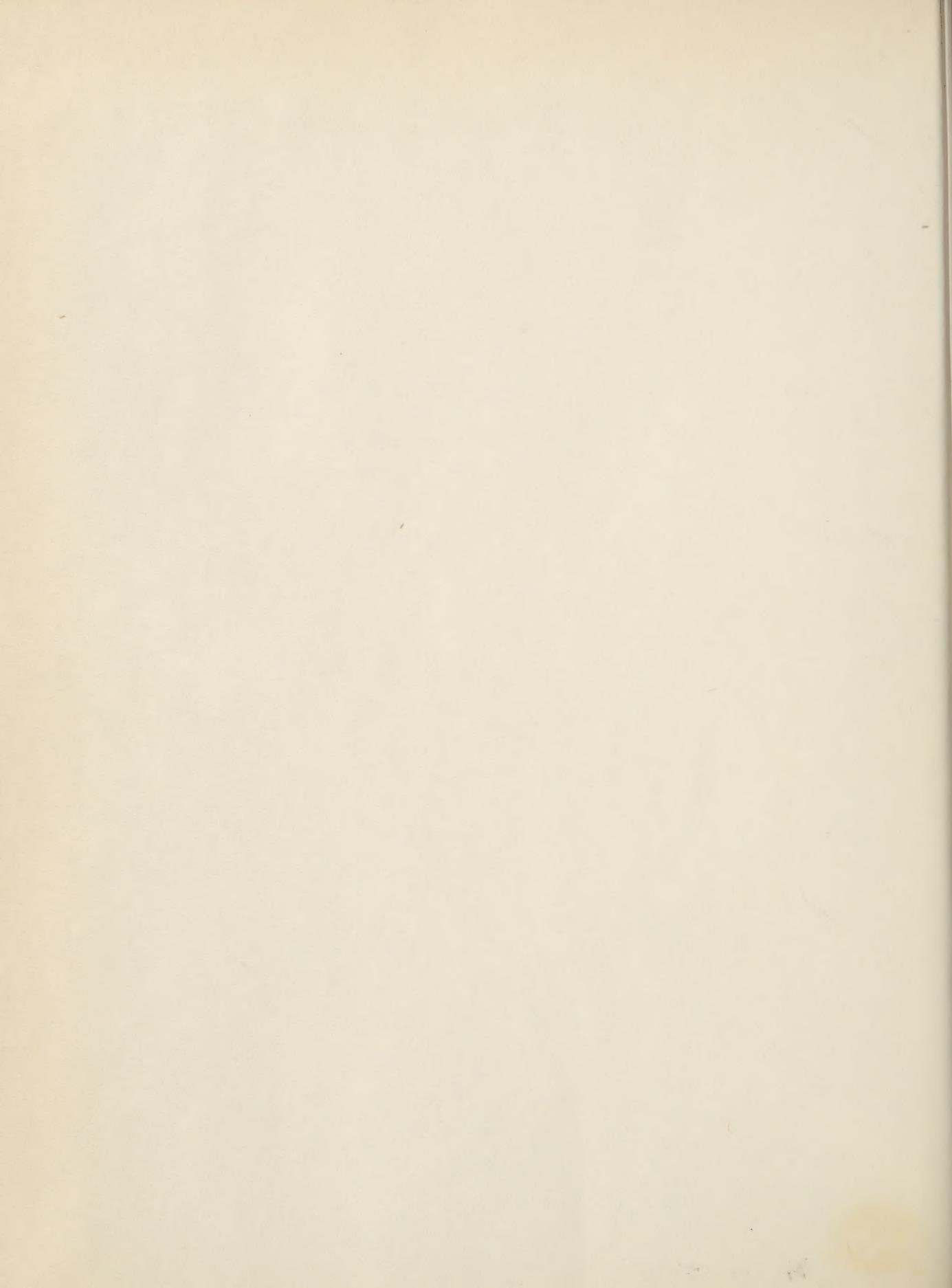
- W -

Walking heel, 289
Warts, plantar, 218
Wernig-Hoffman's muscular dystrophy, 110
Wheelchairs, 295
Wound healing, 46-48
Wound rupture, 47
Wound, scapular region, 233
Wrist, arthritis with fracture, scaphoid, 253
 bipartite navicular, 253
 carpal lunate, 252
 carpal tunnel syndrome, 247
 dislocation of lunate, 253
 drop, 252
 flexor tendon rupture, 252
 fracture radial styloid, 253
 joint, arthrodesis, 252
 injuries, 252
 navicular fracture, 253
 non-union carpal scaphoid, 253
 osteolysis of scaphoid, 254
 vitallium lunate, 253
Wrist and hand, 247-255

- Xanthoma, 144
Xanthomatosis, 29
X-ray, see roentgenology
X-ray, first cervical vertebra, 286
 hip joint, lateral, 286
 hip profile, 286
 lateral, thoracic spine, 286
 measurement, lower extremity, 290
 microradiography, 285, 286
 mounting for fracture table, 287
 muscular dystrophy, 92
 neck, 233
 planigraphy, 285
 skull, disarticulated, 64
 techniques, 285, 286
 variable scale for hip nailing, 287
X-ray therapy, 142, 143
 giant cell tumor, 147

- Yaws, hand, 260

- Zonal laminae, 63
Zonal precipitations, 63





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